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GAI CONSULTANTS INC MONROEVILLE PA
NATIONAL DAM SAFETY PROGRAM. TOWNSHIP LINE DAM (NDI-PA-475), OH--ETC(U)
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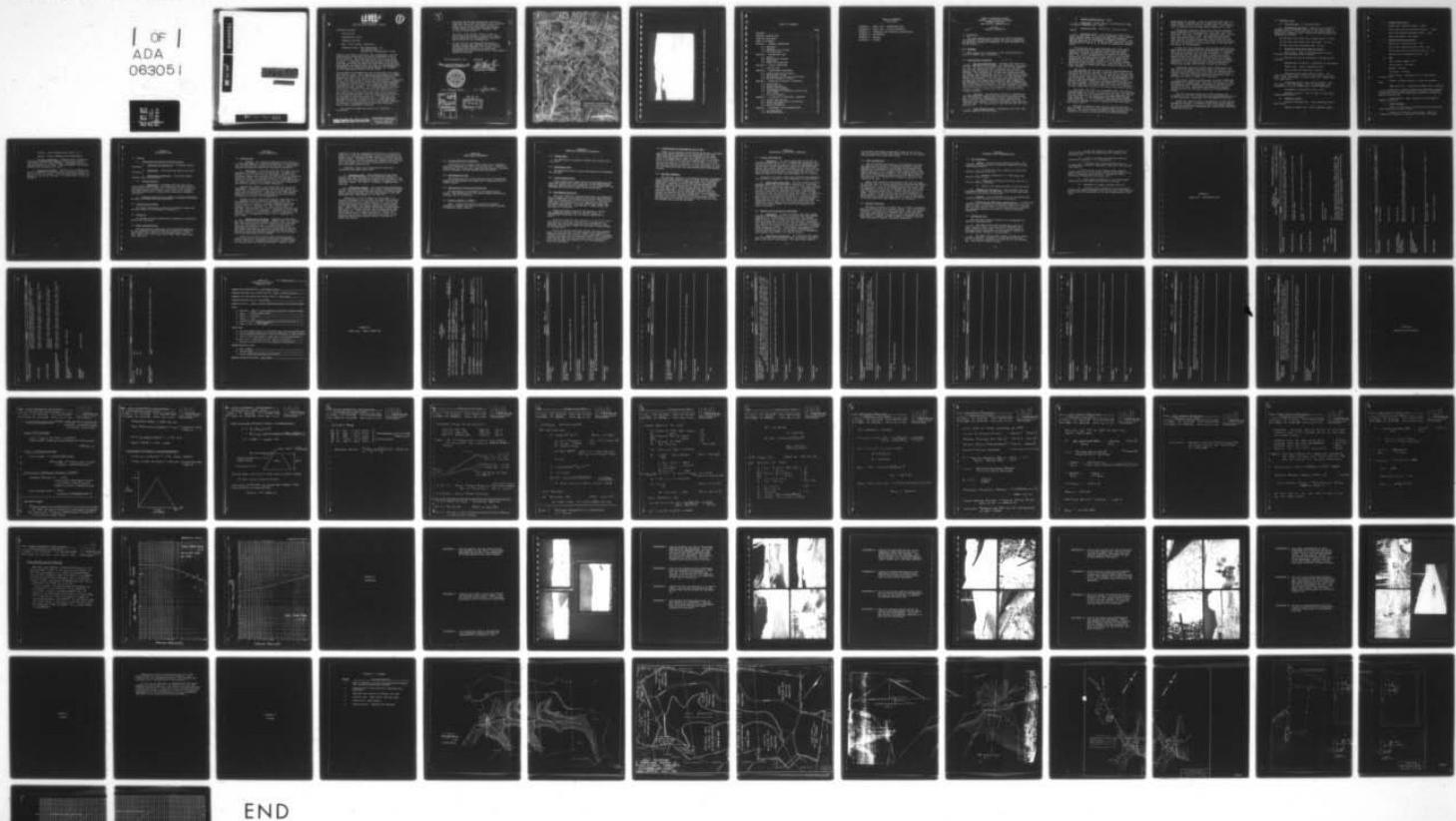
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National Dam Safety Program. Township
Line Dam (NDI-Pa-475), Ohio River Basin,
Township Line Run, Westmoreland County,
Pennsylvania. Phase I Inspection Report.

10

Bernard M. Mihalcin

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LEVEL IV

(1)

PHASE I REPORT National Dam Inspection Program

Township Line Dam

Pennsylvania

Westmoreland County

Township Line Run

May 1, 1978 (visual inspection)

Inspection Team - GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

Based on the visual inspection, past performance, and the engineering calculations, the dam is considered to be in poor condition. The downstream face of the dam is steep (1.5H to 1V) and there are indications that sloughing has occurred. In addition, seepage was observed to be issuing from the toe of the structure and there has apparently been considerable settlement along the crest of the embankment (a difference of 3.3 feet was measured between the abutments and the approximate midpoint of the crest).

The structure is equipped with two 16-inch cast iron supply and blow-off pipes. Both reportedly pass beneath the embankment and are valved on the downstream side permitting full-hydrostatic head at the toe of the structure within the pipes. The owner, does not know, nor were we able to determine, if either of the pipes are functional for drawdown purposes. An additional outlet consists of a concrete weir (wasteway) that empties into a 24-inch terra-cotta pipe which passes through the right abutment. The discharge end of this pipe could not be located and consequently its operability is also suspect. However, even if the above mentioned outlets were functioning at peak efficiency their total capacity plus the storage available from the existing pool elevation at the time of inspection (1272.6) to the low point on the embankment crest (elevation 1281.7 - field measured) can pass and contain a flood of only 0.44 PMF magnitude. Therefore, since the facility is in a high hazard category, its spillway is considered to be seriously inadequate under present embankment conditions.

The following immediate actions are therefore recommended:

i

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1. The owner should take appropriate actions to lower the pool level to elevation 1250 (wasteway overflow = relative datum 1280) and file a status report to the Pennsylvania Department of Environmental Resources (PennDER) after 30 days of notification.
2. The owner should submit within 30 days of notification by PennDER a schedule of investigative measures for the purpose of upgrading the facility for its intended use.
3. In the interim, the owner should develop a 24-hour surveillance schedule for periods of unusually heavy rainfall, and a plan to allow for warning and evacuation of downstream residences who could be effected by a catastrophic failure of the dam.

GAI Consultants, Inc.

Approved:

Bernard M. Mihalcin, P.E.

Bernard M. Mihalcin



Date: June 7, 1978

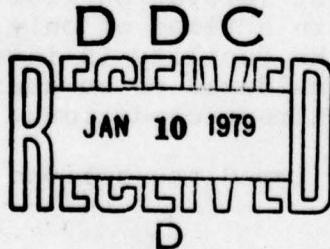
Approved:

John H. Kenworthy

JOHN H. KENWORTHY
LTC, Corps of Engineers
Acting District Engineer

Date: 14 June 1978

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NDI - Pa - 475

**GREENSBURG QUADRANGLE
PENNSYLVANIA-WESTMORELAND CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)**

SCALING

Overview Photograph of Township Line Dam taken from the Right Abutment.

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
TOWNSHIP LINE DAM
NDI# PA-475, PENNDR# 65-33

ABSTRACT
SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

ABSTRACT

a. Dam and Appurtenances. Township Line Dam is an earthen embankment with a puddle core reportedly constructed in 1900. The primary discharge works for the dam consists of a 24-inch terra-cotta pipe, protected by a concrete wastewater (see Photograph 6), and passing through the right abutment. The discharge end of this pipe reportedly exits in a swampy area downstream, however, it could not be located during the field inspection and it is not known whether the outlet is functional. A 16-inch cast iron mud pipe and a 16-inch cast iron supply pipe reportedly pass beneath the dam embankment and could conceivably be used or adapted for use to draw down the reservoir. Outlets to neither of these pipes were located and their utility also remains in question. The upstream face of the dam is mantled with loose stone riprap, whereas the downstream slope is vegetated and was recently grubbed.

b. Location. The Township Line Dam is located near the headwaters of Township Line Run about two miles southeast of Greensburg, Westmoreland County, Pennsylvania. The dam, reservoir, and watershed are contained within the Greensburg and Latrobe 7.5 minute quadrangles (see preceding vicinity map). The coordinates of the dam are N40° 16' 42", W79° 30' 6".

c. Size Classification. Intermediate (68 feet high, storage capacity 1358 acre-feet).

d. Hazard Classification. High.

e. Ownership. Arthur Nobile, 303 Farmington Place, Greensburg, Pennsylvania 15601.

f. Purpose of Dam. Recreation, formerly water supply.

g. Historical Data. The Township Line Dam (also known as Unity Dam) is an earthen embankment (with a puddle core) located about two miles southeast of Greensburg, Pennsylvania, at the headwaters of Township Line Run. The dam was designed by C. W. Knight of Rome, New York, and was constructed in 1900 by H. F. Starck of Greensburg, Pennsylvania.

The facility has a small drainage area (0.58 square miles) and according to PennDER records was partially supplied with water through a 16-inch pipe from Immel Reservoir, located approximately five miles to the southeast. The first recorded detailed report on the dam was prepared by the Water Supply Commission of Pennsylvania (predecessor of PennDER) in 1915. In this report, the examining engineer makes reference to a grouting program which took place between October 1, 1913, and May 7, 1914, when 2127 bags of cement were used to grout 38 holes in the right abutment.

The engineer was not able to assess the performance of the grouting program, however, since the water level in the reservoir was low at that time. He went on to conclude that "in spite of the fact that owing to the storage capacity and to the wasteway, there would appear to be no probability of this dam being overtopped, the writer is firmly of the opinion that there should be a wasteway with no possibility of being clogged. A wasteway can be built in the bank of the left hand end and with a depth of 5 feet and a length of 20 feet would have a capacity in excess of the above figure."

The writer then went on to recommend that "this dam be inspected when it is full, or nearly so, to note its condition and the effect of a full reservoir and the leaks and also to note the effect of the grouting in the bank adjoining the right hand end. It is recommended that the leaks be kept under observation. It is further recommended that additional wasteway be provided to have a capacity of 500 cubic feet per second (cfs)."

The Water Commission then directed the Westmoreland Water Company to report on the effectiveness of the grouting program. The water company apparently complied with the Commission's request by installing weirs and submitting

measurements of leakage. With the reservoir half full, the water company reported that the leakage had been reduced from 350,000 to 30,000 gallons per day (gpd). This information is supplied in a one page report dated July 6, 1916.

Additional inspection reports were filed by the Water Supply Commission of Pennsylvania in June 1919, May 1923, June 1924, July 1927, November 1931, and April 1934. During this time, the reservoir level was apparently kept well below the maximum pool level. The above reports mention small amounts of seepage presumably issuing from the same area that was grouted in 1914. The latter reports also make mention of settlement on the upstream side of the dam near the center of the embankment.

During the 1934 inspection, the engineer noted that "a shaft had been excavated on the upstream slope of the embankment, near the central part of the structure," the purpose of which the engineer was not able to ascertain. Later, it was learned that the owner had sunk a shaft to find the cause for the above mentioned settlement and had removed "loose material" and replaced it with "select clay puddle." Apparently, the structure had been leaking badly as a memo dated May 22, 1934, reports that a grouting program had reduced the leakage from 100,000 to about 15,000 gpd.

Subsequent inspection reports were issued by what was then called the Water and Resource Board in November 1935, May 1941, and November 1948. The latter two reports mention "large amounts of leakage from the toe near the blow-off", however, no records could be obtained to ascertain what, if anything, was done to remedy this situation.

More recent reports issued by the Division of Dams and Encroachments in March 1964, June 1971, and July 1972, make no mention of unsatisfactory conditions at the dam site with the exception of an abundance of vegetative growth on the slopes of the dam. This growth was reportedly cleared periodically by the Municipal Authority of Westmoreland County.

The last reported inspection of the structure was conducted in July 1972 by the Dams and Encroachments Division of the Pennsylvania Department of Environmental Resources.

Within the last few years, the ownership of the dam was changed and the dam is currently owned by Mr. Arthur Nobile. Mr. Nobile intends to use the lake for recreational purposes and has begun erecting townhouses and single family dwellings around the reservoir.

1.3 Pertinent Data.

a. Drainage Area. 0.58 square miles.

b. Discharge at Dam Site. There are no records of discharge being regulated from any of the outlet works at Township Line Dam. The capacities of the outlet pipes at normal pool (wasteway crest - elevation 1280) elevation are estimated as follows:

16-inch cast iron outlet pipe (supply pipe) - 36 cfs.

16-inch cast iron outlet pipe (mud pipe) - 36 cfs.

24-inch terra-cotta wasteway pipe - 57 cfs.

c. Elevation (feet above mean sea level).

Top of Dam - 1281.7 (field measured low point on crest with wasteway crest as datum).

Maximum Pool Design Surcharge - information not available.

Maximum Pool of Record - information not available.

Normal Pool - 1280.0 (wasteway crest).

Pool at Time of Inspection - 1272.6.

Upstream Portal Invert Outlet Conduit - 24" terra-cotta (T.C.) pipe - 1278, 16" cast iron (C.I.) mud pipe - 1221 (estimated), 16" cast iron (C.I.) supply pipe - 1230 (estimated).

Downstream Portal Invert Outlet Conduit - 24" T.C. pipe - 1215 (estimated), 16" C.I. mud pipe - 1215 (estimated), 16" C.I. supply pipe - 1230 (estimated).

Streambed at Centerline of Dam ≈ 1215.

Maximum Tailwater ≈ 1221 (6 feet at first downstream obstruction).

d. Reservoir (feet).

Length of Maximum Pool ≈ 4320 (elevation 1281.7 top of dam).

Length of Normal Pool ≈ 3960 (elevation 1280).

e. Storage (acre-feet).

Normal Pool (elevation 1280) \approx 1490.

Top of Dam (existing elevation 1281.7) \approx 1598.

Top of Dam (design elevation 1285) \approx 1725.

Design Surcharge - Not known.

f. Reservoir Surface (acres).

Normal Pool (elevation 128) \approx 55.

Top of Dam (design elevation 1285) \approx 64.

Top of Dam (existing elevation 1281.7) \approx 58.

Existing Pool (elevation 1272.6) \approx 46.

g. Dam.

Type - Earth (puddle core).

Crest Length - 790 feet.

Height - 68 feet.

Top Width - 12 feet.

Slide Slopes - Upstream 2H to 1V, Downstream
1-1/2H to 1V.

Zoning - Rolled earthfill, riprap on upstream
face.

Impervious Core - Homogeneous puddle core (inferred).

Cut-off - A cut-off trench was reportedly excavated
15 feet beneath the central portion of the dam. The trench
is four feet wide and was reportedly carried up through the
dam to the flow line.

Grout Curtain - None (grouting was performed as
remedial measures).

h. Outlet Conduit.

Type - 16-inch cast iron mud pipe and 16-inch cast
iron supply pipe at base of dam.

Length - 16-inch C.I. supply pipe \approx 350 feet
(inferred), 16-inch C.I. mud pipe \approx 350 feet (inferred).

Closure - None upstream (see Item 1.3.j).

Access - Inlets inundated and inaccessible.

i. Spillway (wasteway). Concrete inlet (elevation 1280 as per construction drawing) connected to 24-inch terra-cotta pipe at right abutment. Estimated length of pipe approximately 225 feet. Inlet accessible from ground surface (above present pool level).

j. Regulating Outlets. 24-inch T.C.P. ungated; not known if operable. 16-inch mud pipe reportedly valved in a pit at the toe of the dam. 16-inch supply pipe valved in a manhole at the toe of the dam. It is not known if they are operable.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design data availability and/or sources.

1. Hydrology and Hydraulics. No design reports available.

2. Embankment. No engineering design data were available.

3. Appurtenant Structures. Structural design analyses were not available.

b. Design Features.

1. Embankment. Available drawings and historical records indicate that the embankment was constructed of rolled earth with a puddle core. The upper slope is mantled with hand placed riprap with a slope of 2H to 1V, whereas the downstream slope is covered with grass and is sloped at 1.5H to 1V.

c. Specific Design Data or Summary of Design Procedures. No specific design data were available.

2.2 Construction Records.

No former construction records are available other than the data shown on the drawings of Appendix E.

2.3 Operation.

No records of formal operational procedures or operating manual were available.

2.4 Other Investigations.

The Pennsylvania Department of Environmental Resources or its predecessor agencies prepared inspection reports on the Township Line Project in the following years: 1915, 1919, 1923, 1924, 1927, 1931, 1934, 1935, 1941, 1948, 1964, 1971, and 1972.

SECTION 3 VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility is favorable, however, a detailed inspection of the structure and its appurtenances suggests that the dam is inadequately designed considering present day engineering practice.

b. Embankment. Available data indicates that the dam embankment is constructed of rolled earth. A puddle core having a width of four feet was reportedly carried from a sandstone foundation up through the flow line of the reservoir (elevation 1280). The upstream slope of the embankment is 2H:1V and the downstream slope is 1.5H:1V. Both the upstream and downstream slopes were apparently recently grubbed and are currently mantled with grassy vegetation.

Seepage was evident in two areas near the toe of the embankment. Although the seepage flow was not excessive (flow could not be measured) the toe was saturated in these areas (see Photograph 13). There were also a few shallow depressions on the downstream embankment face where minor sloughing was evident (see Photograph 9).

Perhaps the most obvious detrimental characteristic of the embankment was the apparent settlement which has occurred near its center. A survey conducted during the field inspection indicated that the freeboard above the wastewater inlet is presently 1.7 feet, not 5.0 feet as designed, implying that 3.3 feet of settlement has occurred near the center of the embankment. Assuming the lip of the wastewater overflow is at elevation 1280.0 (as designed), the low point of the embankment crest is at an elevation of 1281.7 feet.

c. Appurtenant Structures. Township Line Dam does not have a conventional spillway. Rather there is a concrete weir with vertical steel grating located in the right abutment (see Photographs 2 and 6). Water passing over this weir would be directed into a 24-inch tile pipe which reportedly discharges in the valley downstream of the dam. The current and previous owners of the dam did not know if this pipe outlet was currently operable and the discharge end of the pipe could not be located.

There are also two 16-inch pipes (a mud pipe and a supply pipe) which reportedly pass beneath the embankment. A plate covered pit presumably containing a control valve for the mud pipe was located and opened. However, water

impounded in the pit prevented verification or evaluation. Entry to a valve pit containing a three-valve system on the supply line is available through a manhole installed by the present owner. Discussions with the previous owner indicate that this system could be adapted for emergency blow-off use since the supply line has been disconnected in the swamp area downstream from the toe.

Presently, there are no functional outlets for regulating flow and/or pool level.

d. Reservoir Area. Some sedimentation had taken place on the upstream side of the reservoir, however, no surveys have been conducted to gauge the actual amount. The reservoir was circumnavigated to assess the condition of the reservoir slopes. No signs of sliding or sloughing were observed.

e. Downstream Channel. The area directly downstream is characterized as a rather flat, wooded, meandering stream valley. The first downstream restriction is a small bridge which traverses Township Line Run approximately 4,000 feet downstream (see Photographs 14, 16, and 17).

Immediately to the northwest of this bridge is a housing development with at least two homes that would be adversely effected by a sudden dam failure. Loss of the bridge would not be critical as there is roadway access to the development from higher elevations (see location map). About 2,000 feet further downstream a sewage treatment plant is located adjacent the existing stream (see Photograph 18). This facility would undoubtedly suffer severe damage from a sudden dam failure. Within the next mile are three to four dwellings also close to the existing stream which probably would be effected by a sudden dam failure.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedures.

According to the present owner there are no standard operating procedures in effect at the dam site. Inflow and outflow are not, in any way, regulated and the pool elevation varies seasonally through seepage and evaporation.

4.2 Maintenance of Dam.

The downstream face of the dam was clear of vegetation except for low grasses and stumps and is reportedly cut or cleared yearly.

4.3 Maintenance of Operating Facilities.

No maintenance is performed on the existing gate valves. The operability of the outlet system could not be verified and is in question.

4.4 Warning Systems in Effect.

None. Neither are there any specific personnel assigned to inspect the facility during high water periods or unusually heavy rainfall.

SECTION 5 HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No hydrologic or hydraulic design calculations were available.

5.2 Experience Data.

No significant data on past performance were available for analysis.

5.3 Visual Observations.

Since neither the outlet end of the wastewater pipe (24-inch) nor either end of the reported 16-inch outlet pipes could be found during the inspection, it is assumed that the wastewater and the outlet pipes are non-functional.

5.4 Overtopping Potential.

The ratio "PMF Peak Flow/Drainage Area" was determined from an empirical curve supplied by the Baltimore District, Corps of Engineers for the Ohio River Basin. Based on this curve and a drainage area of 0.58 square miles (U.S.G.S. Greensburg and Latrobe 7.5 minute quadrangles dated 1969 and 1973 respectively), Peak PMF Q/A = 2,000 cfs/sq. mi., and Peak Q = 1,160 cfs.

Since the hazard rating of the project is "high", the recommended design flood is the PMF (refer to "Recommended Guidelines for the Safety Inspection of Dams").

Using the existing pool elevation of 1272.6 feet and a flow period of 30 hours, calculations (see Appendix C) indicate that during the PMF the inflow volume of 1,438 acre-feet will greatly exceed the available storage volume of 334 acre-feet.

If all of the existing pipe systems (24-inch wastewater pipe, 16-inch mud pipe, 16-inch supply) were adapted for discharge and were functioning at peak efficiency, the total storage available plus the discharge volume over the 30-hour storm period would be 654 acre-feet, which is still much less than the PMF (see Appendix C) and the embankment would be overtopped.

5.5 Significance of Overtopping Due to SDF.

Based on an analysis of downstream conditions, tailwater depth just before overtopping is estimated as six feet. This condition would occur at the location of the first paved road approximately 4000 feet downstream of the dam. Since a few homes and a sewage treatment plant are located on or just above the flood plain (see Section 3.1.3) and because overtopping is expected to cause embankment failure, overtopping would significantly increase the hazard to loss of life downstream from that which would exist just before failure.

5.6 Spillway Adequacy.

The spillway capacity is considered seriously inadequate since the project hazard rating is "high" and the facility cannot pass a flood of 0.5 PMF magnitude in its existing condition. Analysis utilizing the storage capacity from the existing pool level of 1272.6 feet to the embankment crest of 1281.7 feet indicates the project will pass 0.44 PMF peak flow. If the embankment were raised to elevation 1285 the project would pass 0.58 PMF with all outlets functioning and the spillway would be considered inadequate, but not seriously inadequate. It is emphasized, however, that these calculations are presumptive in that the operability of neither the supply line, blow-off line, or wasteway pipe could be verified.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. The downstream slope of the dam is relatively steep (1.5H to 1V). Seepage was observed to be issuing from two points near the toe of the embankment where the phreatic surface apparently intersects the downstream slope. Many rodent holes were present in the lower half of the downstream face and water was encountered in one of the holes located approximately 15 feet above the dam toe at a depth of about 1-1/2 feet (see Photographs 10, 11, and 12).

Because of the steep slopes and saturated toe condition, the structural integrity of the embankment is questionable.

b. Appurtenant Structures. The only outlet structure observed during the investigation consisted of a concrete wasteway (weir discharging into a 24-inch tile pipe) located in the right abutment (see Photograph 6). The discharge end of this outlet was not observed during our investigation, nor was it possible to ascertain its exact location after interviewing the previous and present dam owner. In addition, the inlet to this structure consisted of a vertical steel grate which is considered to be prone to clogging by debris. Water passing over this weir drops into a narrow chamber containing the 24-inch tile pipe on the downstream end. The possibility then remains that the upper end of the pipe could then become clogged with drift thus rendering the outlet inoperable.

6.2 Design and Construction Techniques.

a. Embankment. A report issued by the Water Supply Commission of Pennsylvania in 1915 states that the dam was constructed of rolled earth and contains a clay puddle measuring four feet in width carried from a bedrock foundation up through the flow line of the reservoir. Construction techniques during the early 1900's consisted of dumping the earth in thin layers and rolling the material with horse drawn segmented rollers. "Clay puddle" was usually sluiced into the embankment "core" as the earth embankments on either side were raised. The Township Line Run embankment was probably constructed in a similar manner.

b. Appurtenant Structures. No information was available concerning the techniques used to construct the waste-way or the two 16-inch outlets. The 1915 report refers

to the above and simply states that "both of the 16-inch cast iron pipes are below the natural surface of the ground and are built with piers under them."

6.3 Past Performance.

The old records and reports on the Township Line Dam are replete with reference to leakage problems, grouting programs, and references to times when the reservoir was emptied for investigations and remedial construction (see History Section 1.2.g). However, more recent reports (post 1940) published by the PennDER or its predecessors make no mention of unsatisfactory conditions at the dam site with the exception of an abundance of vegetative growth on the slopes of the dam.

Water level readings taken between 1967 and 1975 seem to indicate that the highest recent pool elevation was approximately 1273 feet, or the approximate pool level at the time of inspection. There is no indication that the water level has exceeded this elevation or reached the level of the 24-inch terra-cotta outlet pipe in recent history (elevation 1280). Should the water level rise to this elevation, it would be only 1.7 feet from the low point in the dam crest, since there has apparently been about 3.3 feet of settlement of the dam crest near the midpoint of the structure.

6.4 Seismic Stability.

The dam is located in Seismic Zone 1 and may, therefore, only be subjected to minor seismic forces. With the observed saturated toe condition, steep downstream slope, and record of having a hydraulic fill (puddle) core, it is possible that even small dynamic forces could be significant at high pool levels. However, no design report or seismic calculations were made to support the above conclusion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment.

a. Safety. The following conditions suggest that Township Line Dam presents a potential hazard to life and downstream property:

1. A relatively steep, downstream slope that exhibits seepage at the toe.

2. Minimal freeboard of 1.7 feet above the design overflow level.

3. Inadequate discharge facilities that may in fact be totally inoperable.

4. Lack of any operating plan or warning system.

b. Adequacy of Information. The available data was considered sufficient to make broad observations and recommendations concerning the structure.

c. Urgency. It is suggested that the recommendations listed below be implemented as soon as possible.

d. Necessity for Additional Investigation. An additional investigation to determine an acceptable pool level for the facility under steady-state and seismic loading is necessary. Such an investigation would include assessing the nature of the embankment material and their in-place engineering properties.

7.2 Recommendations.

The following remedial measures are recommended for immediate implementation:

a. The owner should take appropriate actions to lower the pool level to elevation 1250 (wasteway overflow = relative datum 1280) and file a status report to the Pennsylvania Department of Environmental Resources (PennDER) within 30 days of notification.

b. The owner should submit within 30 days of notification by PennDER a schedule of investigative measures for the purpose of upgrading the facility for its intended use. The schedule should include:

1. A plan for evaluation and/or upgrading of the existing mud pipe and supply pipe for drawdown and regulatory use.

2. A plan to evaluate the existing overflow system and determine if it is functional.

3. A schedule for a detailed evaluation of the embankment materials, embankment stability, and spillway requirements.

c. In the interim, a surveillance plan, warning system and/or plan of evacuation should be developed in the event of unusually heavy rainfall. Residences and/or facilities considered hazard prone are:

1. Two closest residences to first downstream improvement and the barn near the toe of the dam.

2. Personnel at sewage treatment facility.

3. Possibly three residences on the floodplain between the sewage treatment facility and the fourth improved road encountered downstream of the dam (approximately 9,000 feet).

APPENDIX A

CHECK LIST - ENGINEERING DATA

ITEM	CHECK LIST ENGINEERING DATA	NAME OF DAM Township Line Dam	ID # NDI# PA-475, PennDER# 65-33	SHEET 1
REMARKS				
AS-BUILT DRAWINGS	Good as built topo from 1900; property survey; proposed plan with x-section; pump station plan; piping plan; capacity curve	Project is shown on Greensburg and Latrobe, Pennsylvania USGS Quadrangle sheets.		
REGIONAL VICINITY MAP				
CONSTRUCTION HISTORY		PA.DER report No. 65-33-1 makes reference to the construction history.		
TYPICAL SECTIONS OF DAM		One section shown on plan of proposed reservoir		
OUTLETS - PLAN		Pump station plan		
- DETAILS		Piping plan		
- DISCHARGE RATINGS		N/A		
RAINFALL/RESERVOIR RECORDS		Rainfall records available at site. Woman in farmhouse near the dam keeps records for the National Weather Service. Some reservoir records are available particularly for the period 1967 to 1975. (These data are available from the Westmoreland Co. Municipal Authority - former owner).		

ITEM	REMARKS	ID # PA-475	SHEET 2
DESIGN REPORTS	None available		
GEOLOGY REPORTS	None available		
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available		Some of the old PA.DER inspection reports make mention of seepage studies and the installation of weirs to monitor seepage.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available		
POST-CONSTRUCTION SURVEYS OF DAM		The post construction contours are shown on a drawing, (Figure 1) dated April, 1900.	
BORROW SOURCES		Information not available	

ITEM	ID #	PA-475	SHEET 3
REMARKS			
MONITORING SYSTEMS	At one time there reportedly was a calibrated log (staff gauge) near the middle of the Township Line embankment. Records may be available from the previous owner.		
MODIFICATIONS	PA.DER inspection reports mention grouting programs at various times as well as other remedial construction measures.		
HIGH POOL RECORDS	Daily pool level readings for the period 1967 to 1975 were supplied by the owner, however no high pool records were available.		
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	PA.DER inspection reports were issued in 1915, 1916, 1919, 1923, 1924, 1927, 1931, 1934, 1935, 1941, 1948, 1964, 1971 & 1972.		
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None available		
Maintenance OPERATION RECORDS	None available		

ITEM	REMARKS	ID #	PA-475	SHEET 4
SPILLWAY PLAN	N/A			
SECTIONS	N/A			
DETAILS	N/A			

OPERATING EQUIPMENT
PLANS & DETAILS

A pump station and piping supply plan were supplied by a former owner.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

ID # NDI# PA-475

DRAINAGE AREA CHARACTERISTICS: 0.58 Square Miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1280 - (1490 Acre Ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not Known

ELEVATION MAXIMUM DESIGN POOL: Not Known

ELEVATION TOP DAM: 1281.7 (Field measured low point on crest of dam)

CREST:

- a. Elevation 1281.7 (Field measured low point on crest of dam)
- b. Type Earth (grass cover)
- c. Width 12 Feet
- d. Length 790
- e. Location Spillover Wasteway structure and 24-inch T.C.P. at right abutment.
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 16" supply pipe; 16" blow-off pipe; 24" terra-cotta pipe
- b. Location Beneath embankment; beneath embankment; right abutment
- c. Entrance Inverts 1230 (Est.); 1221 (Est.); 1278 respectively
- d. Exit Inverts 1230 (Est.); 1215 (Est.); 1215 (Est.)
- e. Emergency Draindown Facilities 16" blow-off ("mud-pipe")

HYDROMETEOROLOGICAL GAGES:

- a. Type None
- b. Location None
- c. Records Some old records are available

MAXIMUM NON-DAMAGING DISCHARGE: Not Known

APPENDIX B
CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

DAM NAME	Township Line Run	COUNTY	Westmoreland	STATE	PA	NDI#	PA-475
TYPE OF DAM	Earth (Puddle Core)	HAZARD	CATEGORY	Significant		ID #	PennDER 65-33
DATE (S)	INSPECTION	5-1-78	WEATHER	Mostly sunny and mild	TEMPERATURE	35° - 55°	

POOL ELEVATION AT TIME OF INSPECTION 1272.6 M.S.L. TAILWATER AT TIME OF INSPECTION N/A M.S.L.
Lowest elevation of embankment 1281.7

INSPECTION PERSONNEL:

B. M. Mihalcin	D. J. Nebiolo	Owners Representative: Arthur Nobile
J. P. Nairn		
K. H. Khilji		

J. P. Nairn RECORDER.

VISUAL EXAMINATION OF		EMBANKMENT	ID#PA 475	Sheet 1
	OBSERVATIONS			REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None			
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Some minor sloughing of the embankment at the toe.			
SLoughing or Erosion of embankment and abutment Slopes	Numerous shallow depressions are in evidence on the downstream dam face.			
Vertical and horizontal alignment of the crest	The crest of the dam was horizontally aligned. However, there was as much as 3.5 feet of settlement across the crest of the dam.			
RIPRAP FAILURES	None			

EMBANKMENT ID # PA 475

SHEET 2

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

JUNCTION OF EMBANKMENT
AND ABUTMENT, SPILLWAY
AND DAM

No signs of distress.

ANY NOTICEABLE SEEPAGE

Seepage was noted at a number of locations near the toe of the embankment.

STAFF GAGE AND RECORDER

None

DRAINS

None

OUTLET WORKS

ID # PA 475

SHEET 3

VISUAL EXAMINATION OF

CRACKING AND SPALLING OF
CONCRETE SURFACES IN
OUTLET CONDUIT

The dam is reportedly provided with a 16-inch cast iron mud pipe. Neither this pipe nor any appurtenances (gates, valves, etc.) were observed at the time of inspection. The mud pipe is not thought to be functional at this time. An additional 16-inch cast iron pipe supplied water to Dry Ridge Reservoir. This pipe could conceivably be used as an outlet but was reportedly plugged a few years ago.

INTAKE STRUCTURE

Both of the above mentioned pipes reportedly pass beneath the embankment and their inlets are submerged.

OUTLET STRUCTURE

Not observed.

OUTLET CHANNEL

None

EMERGENCY GATE

None

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

UNGATED SPILLWAY ID #PA 475 SHEET 4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The reservoir is provided with a concrete weir with vertical grating in the right abutment which directs water into a 24-inch terra-cotta pipe. Reportedly, this pipe discharges into the natural stream valley approximately 225 feet downstream of the dam, however, we were not able to locate the discharge end of the pipe.	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A See explanation above.	
BRIDGE AND PIERS	N/A	

The reservoir is provided with a concrete weir with vertical grating in the right abutment which directs water into a 24-inch terra-cotta pipe. Reportedly, this pipe discharges into the natural stream valley approximately 225 feet downstream of the dam, however, we were not able to locate the discharge end of the pipe.

APPROACH CHANNEL
N/A

DISCHARGE CHANNEL
N/A See explanation above.

BRIDGE AND PIERS
N/A

GATED SPILLWAY ID #PA 475 SHEET 5

VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS

CONCRETE SILL

N/A

APPROACH CHANNEL

N/A

DISCHARGE CHANNEL

N/A

BRIDGE AND PIERS

N/A

GATES AND OPERATION
EQUIPMENT

N/A

SHEET 6

INSTRUMENTATION ID # PA 475

VISUAL EXAMINATION

MONUMENTATION/SURVEYS

None

OBSERVATIONS

OBSERVATION WELLS

None

WEIRS

None - With the exception of the wastewater referred to in section on ungated spillway.

PIEZOMETERS

None

OTHERS

None

REMARKS OR RECOMMENDATIONS

VISUAL EXAMINATION OF	RESERVOIR	ID # PA	475	SHEET 7
SLOPES	OBSERVATIONS	REMARKS OR RECOMMENDATIONS		
	The slopes surrounding the reservoir are mostly wooded and vary between 2.5 and 18 percent.			

SEDIMENTATION

Because of such things as good vegetative covering, small drainage area and gentle slopes sedimentation appears to have been minimal. Old photos of the reservoir support this statement.

DOWNSTREAM CHANNEL

ID # PA 475

SHEET 8

VISUAL EXAMINATION OF OBSERVATIONS

CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) Township Line Run flows through a heavily vegetated, gentle, swampy, and moderately wide (≈ 200 feet) valley. With the exception of the house, barn, and Route 130 which are situated within a few hundred feet of the toe of the dam, no improvements are encountered until the stream passes beneath a paved road ≈ 4000 feet downstream.

SLOPES

The wooded slopes bordering the downstream channel rise above the Township Line Run valley to heights averaging 140 feet. These slopes commonly approach 25 percent.

APPROXIMATE NO. OF HOMES AND POPULATION

2 to 4 homes
1 sewage treatment facility } 20 persons

APPENDIX C
HYDRAULICS AND HYDROLOGY

SUB CT DAM SAFETY PROGRAM
TOWNSHIP LINE DAM
BY LTS DATE 5-2-78 PROJ. NO. 78-501-475
CHIEF DLY DLB DATE 5-3-78 SHEET NO. 1 OF 17



TOWNSHIP LINE DAM (#475) - GREENSBURG QUADRANGLE
LATROBE QUADRANGLE
7.5 MINUTE USGS MAP

DAM STATISTICS

MAX. HEIGHT OF DAM = 68 FT
DRAINAGE AREA (PLANIMETERED) = 370 ACRES
= .58 SQ. MI.

SIZE CLASSIFICATION

DAM SIZE = INTERMEDIATE

BECAUSE $HT \geq 40$ AND < 100
(TABLE 1, REFERENCE 1)

SPILLWAY DESIGN FLOW (SDF)

HAZARD RATING = HIGH

- SEWAGE TREATMENT PLANT
- 2 HOUSES NEAR BANK
(REF. 2, VISUAL INSPECTION)

REQUIRED SDF = PMF
(TABLE 3, REFERENCE 1)

REFERENCES:

- ① "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS"
BY: DEPT. OF ARMY - OFFICE OF CHIEF ENGR - APPENDIX D
- ② "CHECKLIST - VISUAL INSPECTION - PHASE I"
TOWNSHIP LINE DAM

SUBJECT DAM SAFETY PROGRAM
TOWNSHIP LINE DAM
BY JTS DATE 5-2-78 PROJ. NO. 78-501-475
CHG'D. BY JLB DATE 5-3-78 SHEET NO. 2 OF 17



$$\text{DRAINAGE AREA} = 0.58 \text{ SQ. MI}$$

$$\text{PMF (PEAK FLOW/AREA)} = 2000 \quad (\text{EXTRAPOLATED DATA})$$

SHEET 14

$$\text{PMF} = (0.58)(2000) = 1160 \text{ CFS}$$

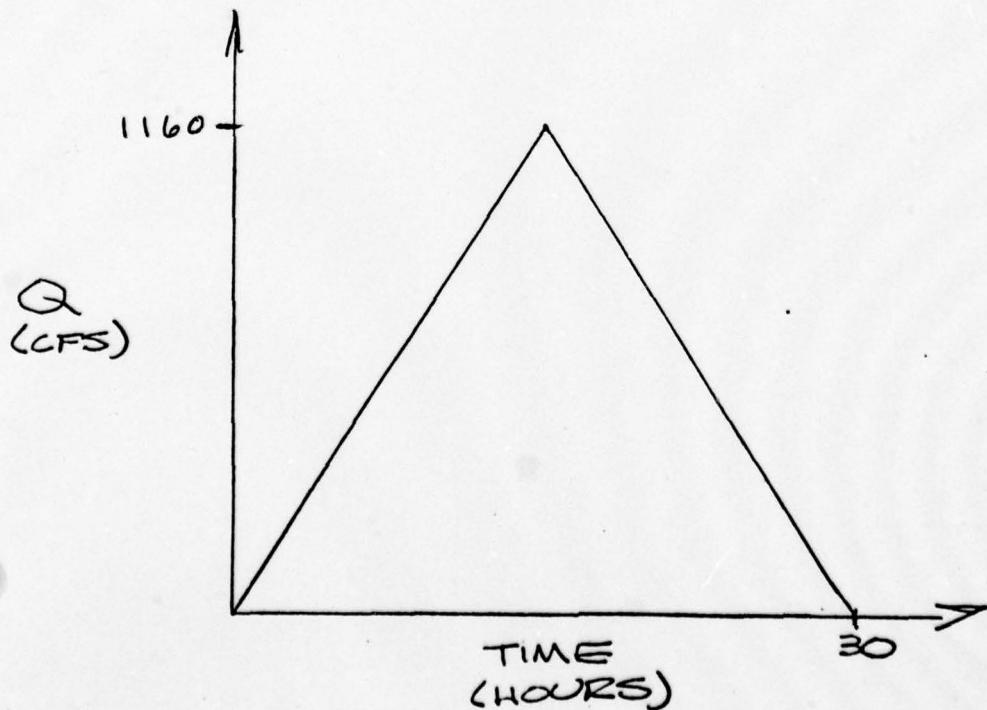
$$\text{SDF} = \text{PMF} = 1160 \text{ CFS}$$

DEVELOP INFLOW HYDROGRAPH

$$\text{MAXIMUM INFLOW} = 1160 \text{ CFS (SDF)}$$

$$\text{TOTAL TIME OF FLOW} = 30 \text{ HRS.} \quad (\text{EXTRAPOLATED DATA})$$

SHEET 15



JECT DAM SAFETY PROGRAM
TOWNSHIP LINE DAM

ITS DATE 5-2-78 PROJ. NO. 78-501-475
 GRT 5-10-78
 CHKD. BY DLB DATE 5-3-78 SHEET NO. 3 OF 17

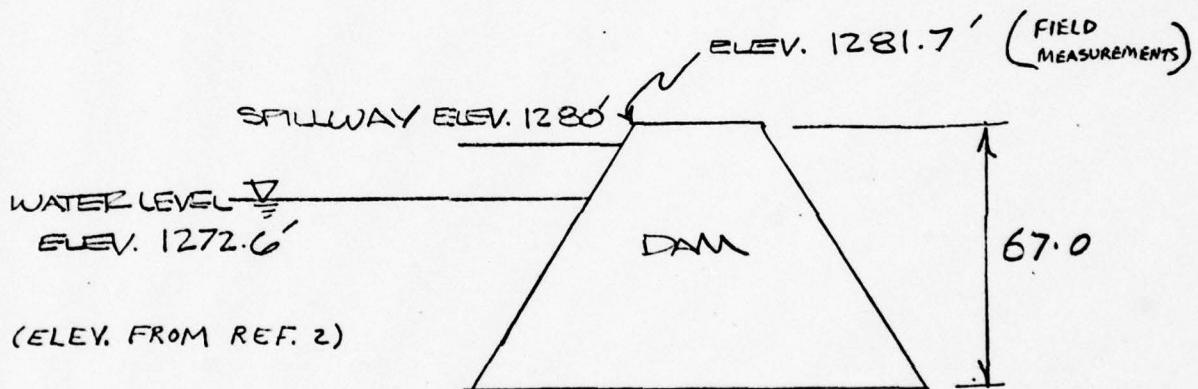


TOTAL VOLUME OF FLOW FROM HYDROGRAPH

$$V = \frac{1}{2} (Q_{\max})(T)$$

$$= \frac{1}{2} (1160 \text{ cfs}) (30 \text{ hrs}) (3600 \frac{\text{sec}}{\text{hr}}) \left(\frac{1 \text{ acre}}{43560 \text{ ft}^2} \right)$$

$$V = 1438.0 \text{ acre-ft}$$



① CONSIDER SPILLWAY PIPE AND OUTLET PIPES
 TO BE NON-FUNCTIONAL:

AVAILABLE STORAGE VOLUME BETWEEN THE
 FOLLOWING ELEVATIONS:

$$1272.6 \rightarrow 1281.7$$

OBJ. ST DAM SAFETY PROGRAM
TOWNSHIP LINE DAM
IY TS DATE 5-2-78 PROJ. NO. 78-501-475
Hkd. BY DLB DATE 5-3-78 SHEET NO. 4 OF 17



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RESERVOIR AREAS

- @ EL 1270 = 43.2 ACRES
- @ EL 1280 = 55.3 ACRES
- @ EL 1285 = 64.0 ACRES
- @ EL 1272.6 = 46.3 ACRES
- @ EL 1281.7 = 58.2 ACRES

} PLANIMETERED (DRWG 97-146F)
CITIZENS WATER CO.
} INTERPOLATED

$$\text{AVAILABLE VOLUME} = \left[\frac{(58.2 + 46.3)}{2} \right] (9.1 \text{ FT}) = 475.5 \text{ AC-FT}$$

SUBJECT

TOWNSHIP LINE DAM

BY DLB DATE 5-11-78 PROJ. NO. 78-501-475
CH JY KHL DATE 5/13/78 SHEET NO. 5 OF 17



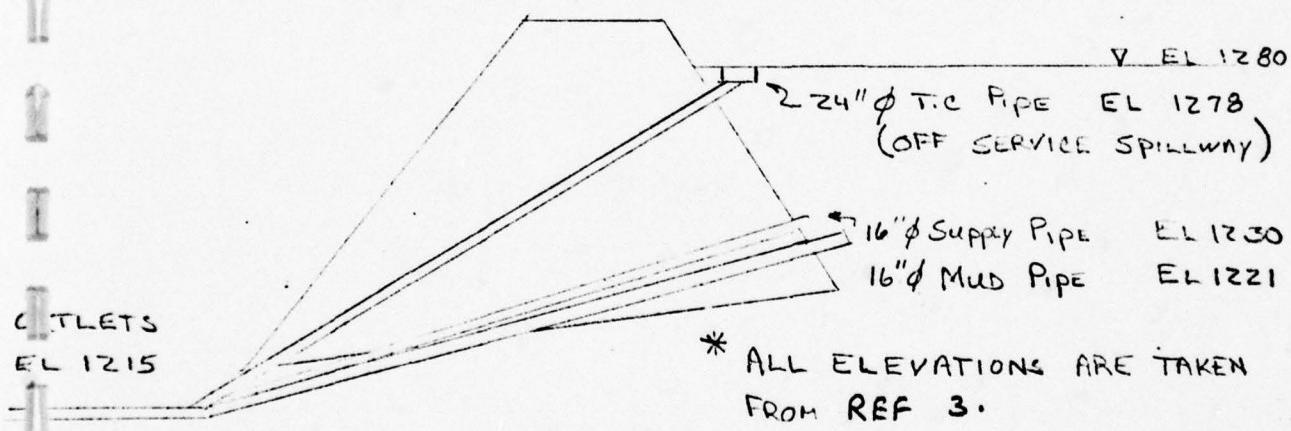
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CONSIDER 3 PIPES TO BE FUNCTIONAL

16"φ C.I. MUD PIPE	(350 LF)	REF 3
16"φ C.I. Supply Pipe	(350 LF)	REF 3
24"φ T.C. WASTEWAY PIPE	(225 LF)	REF 4

NOTE: THE 16"φ SUPPLY PIPE IS ASSUMED TO BE ADAPTABLE
AS A DISCHARGE PIPE SHOULD THE CONDITIONS DICTATE IT
AS SUCH.



24"φ PIPE INLET CONTROL CONDITION (PIPE NOT FLOWING FULL) (DUE TO INSUFFICIENT HEAD AND STEEP GRADIENT) (REF 5 pg 161)

2-16"φ PIPES OUTLET CONTROL CONDITION

REF 3 : DRWG # 97-146 R WESTMORELAND WATER CO

REF 4 : APR 29, 1915 REPORT ON UNITY DAM

REF 5 : "HANDBOOK OF STEEL DRAINAGE & HIGHWAY CONSTRUCTION PRODUCTS"
AMER. IRON & STEEL INSTITUTE

UBJ T

TOWNSHIP LINE DAM

BY DLB DATE 5-11-78 PROJ. NO. 7A-501-475
 HKD. BY KHL DATE 5/13/78 SHEET NO. 6 OF 17



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24"φ PIPE (NOT FLOWING FULL)

USING HAZEN-WILLIAMS

$$V = 1.318 C_s R^{0.63} S^{0.54} \quad (\text{REF } 6 \text{ EQ 21-34a})$$

$$C_s = \text{COEF. OF ROUGHNESS} = 80 \quad (\text{REF } 6 \text{ TABLE 21-5})$$

$$S = \text{SLOPE} = 70/225 = 0.31$$

$$R = \text{HYDRAULIC RADIUS}$$

$$R = (k_2 \pi r^2) / (4Vr) \quad \text{WHERE } r = 1' \text{ AND ASSUMING THE PIPE TO BE FLOWING } \frac{1}{2} \text{ FULL}$$

$$R = 0.5$$

$$V = 1.318(80)(.5)^{0.63}(0.31)^{0.54}$$

$$V = 36.2 \text{ ft/sec}$$

$$Q_{21} = V A = (36.2 \text{ ft/s})(\frac{1}{2})(\pi)(1 \text{ ft})^2 = \underline{\underline{56.9 \text{ ft/sec}}}$$

$$A = \text{CROSS-SECTIONAL AREA OF STREAM} = \pi R^2 / 2$$

16"φ MUD PIPE

USE BERNOUILLI EQ.

(REF 6 EQ 21-12)

$$z_1 + p_1/w + v_1^2/2g = z_2 + p_2/w + v_2^2/2g + h_f + h_c$$

REF: 6 "STANDARD HANDBOOK FOR CIVIL ENGINEERS"
F. S. MERRITT

SUBJECT

TOWNSHIP LINE DAM

Y 213
Hkd. By KAHDATE 5-11-78
DATE 5/12/78PROJ. NO. 78-501-475
SHEET NO. 7 OF 17CONSULTANTS, INC.
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ASSUME DATUM AT EL 1215

 $Z_1 = \text{HEIGHT OF INLET ABOVE DATUM}$ $= 6'$ $Z_2 = \text{" OUTLET " "$ $= 0$ $P_1/w = \text{PRESSURE HEAD AT INLET}$ $= 59'$ $P_2/w = \text{" " " OUTLET}$ $= 0$ $V_1 = \text{VELOCITY AT INLET}$ $= 0$ $V_2 = \text{EXIT VELOCITY}$ $= \text{SOLVE FOR }$ $h_f = \text{HEAD LOSS DUE TO FRICTION}$

$$h_f = f \frac{LV^2}{2gD} \quad \text{DARCY - WEISBACH} \quad (\text{REF 6 EQ 21-30})$$

 $L = \text{PIPE LENGTH} = 350 \text{ FT}$ $V = \text{VELOCITY} = \text{SOLVE FOR}$ $g = 32.2 \text{ FT/SEC}^2$ $D = \text{DIAMETER} = 1.30 \text{ FT}$

(Ref 6, TABLE 21-3)
 Fig 21-19 $f = 0.017$ FOR REYNOLDS $\approx 1.0 \times 10^7$, $\epsilon = 0.00085$
 (TYPICAL FOR TURBULENT FLOW)

 $h_e = \text{HEAD LOSS AT ENTRANCE}$

$$h_e = K_e \frac{V^2}{2g} \quad (\text{REF 6 EQ 21-42})$$

 $K_e = \text{LOSS COEFF} = 0.50$ $(\text{REF 6 TABLE 21-7})$

SOLVE BERNOULLI'S EQ

$$6' + 59' + 0 = 0 + 0 + \frac{V_2^2}{2(32.2)} + \frac{(0.017)(350)V_2^2}{2(32.2)(1.3)} + (0.50) \frac{V_2^2}{2(32.2)}$$

$$65' = 0.016 V_2^2 + 0.071 V_2^2 + 0.008 V_2^2$$

SUB. CT

TOWNSHIP LINE DAM

BY DLR DATE 5-11-78 PROJ. NO. 78-501-475
 CHK'D BY KHL DATE 5/13/78 SHEET NO. 8 OF 17



$$V_2^2 = 65' / 0.095$$

$$V_2 = 26.2 \text{ f/s}$$

$$Q = VA = (26.2 \text{ f/s})(\pi)(0.67)^2$$

$$\underline{Q_{16} = 36.9 \text{ cfs}}$$

16"φ Supply Pipe (SAME AS 16"φ Mud Pipe)

USE BERNOUILLI EQ AGAIN

Z_1 = HEIGHT OF INLET ABOVE DAMUM = 15'

Z_2 = " " OUTLET " " = 0

P_1/w = PRESSURE HEAD AT INLET = 50'

P_2/w = " " OUTLET = 0

V_1 = VELOCITY AT INLET = 0

V_2 = EXIT VELOCITY = SOLVE FOR

L = PIPE LENGTH = 350'

q = $(32.2 \text{ ft/s})^2$

D = DIAMETER = 1.3'

f = 0.017 (SAME AS OTHER 16"φ PIPE)

K_E = 0.50 (SAME AS OTHER 16"φ PIPE)

JECT DAM SAFETY INSPECTION
TOWNSHIP LINE DAM

Y DLB DATE 5-22-78 PROJ. NO. 78-501-475
CHKD. BY KHL DATE 5/22/78 SHEET NO. 9 OF 17



SOLVE BERNOUILLI'S EQUATION

$$15' + 50' + 0 = 0 + 0 + \frac{V_2^2}{2(32.2)} + \frac{(0.017)(350')V_2^2}{(2)(32.2)(1.3)} + \frac{(0.50')(V_2^2)}{2(32.2)}$$

$$65' = 0.016 V_2^2 + 0.071 V_2^2 + 0.008 V_2^2$$

$$V_2^2 = 65' / 0.095$$

$$V_2 = 26.2 \text{ Fps}$$

$$Q_{16_2} = \sqrt{A} = (26.2 \text{ Fps})(\pi)(0.67')^2$$

$$Q_{16_2} = 36.9 \text{ cfs}$$

$$Q_{TOTAL} = Q_{24} + Q_{16_1} + Q_{16_2} = (56.9 \text{ cfs}) + (36.9 \text{ cfs}) + (36.9 \text{ cfs})$$

$$Q_{TOTAL} = 130.7 \text{ cfs}$$

SUBJECT DAM SAFETY INSPECTION

TOWNSHIP LINE DAM

BY DLB DATE 5-22-78 PROJ. NO. 78-501-475

CHKD. BY KHK DATE 5-23-78 SHEET NO. 10 OF 17



USING SHORT CUT METHOD SUGGESTED BY NAD.

VOLUME OF STORAGE AVAILABLE = 475.5 AC-FT (SHEET 3)

MAXIMUM DISCHARGE RATE (Q_{TOTAL}) = 130.7 CFS (SHEET 9)

MAXIMUM INFLOW (PMF PEAK INFLOW) = 1160 CFS (SHEET 2)

VOLUME OF FLOW FROM HYDROGRAPH = 719.0 ACRE-FT (SHEET 3)

$$P = \frac{\text{MAXIMUM DISCHARGE RATE}}{\text{MAXIMUM INFLOW (SDF)}} = \frac{130.7}{1160.0} = 0.11$$

$$1 - P = \frac{\text{REQUIRED RESERVOIR STORAGE}}{\text{VOLUME OF INFLOW HYDROGRAPH}}$$

$$(1 - 0.11) = \frac{R.R.S.}{1438.0}$$

$$\begin{aligned} \text{REQUIRED RESERVOIR STORAGE} &= (0.89)(1438 \text{ ACRE-FT}) \\ &= 1280 \text{ ACRE-FT} \end{aligned}$$

VOLUME STORAGE AVAILABLE < REQUIRED STORAGE VOLUME
475.5 AC-FT < 1280 AC-FT

CONCLUSION: TOWNSHIP LINE DAM WILL BE OVERTOPPED BY
AN SDF = PMF

OBJECT DAM SAFETY INSPECTION
TOWNSHIP LINE DAM
BY DLB DATE 5-23-78 PROJ. NO. 78-501-475
CHKD. BY KML DATE 5/23/78 SHEET NO. 11 OF 17



ESTABLISH WHAT PMF OR SDF THE DAM WILL
CONTAIN AND/OR PASS

$$P = \frac{\text{MAX DISCHARGE RATE}}{Q_{IMAX}} = \frac{130.7 \text{ CFS}}{Q_{IMAX}} \quad (\text{SHEET } 9)$$

$$1 - P = \frac{\text{AVAILABLE STORAGE VOLUME}^*}{\text{VOLUME OF INFLOW HYDROGRAPH}} = * \quad (\text{SHEET } 4)$$

$$1 - \frac{130.7 \text{ CFS}}{Q_{IMAX}} = \frac{475.5 \text{ ACRE FT}}{1/2 (Q_{IMAX}) (30 \text{ HRS}) (3600 \text{ SEC/HR}) (1 \text{ ACRE}/43,560 \text{ FT}^2)}$$

$$1 - \frac{130.7 \text{ CFS}}{Q_{IMAX}} = \frac{475.5}{1.24 Q_{IMAX}}$$

$$1.24 Q_{IMAX} = 637.6 \text{ cfs}$$

$$Q_{IMAX} = 514 \text{ CFS}$$

$$\text{PMF (PEAK INFLOW)} = 1160 \text{ cfs} \quad (\text{SHEET } 2)$$

$$Q_{IMAX} = 44.3 \% \text{ PMF}$$

OBJECT DAM SAFETY INSPECTION
TOWNSHIP LINE DAM
BY DLB DATE 5-23-78 PROJ. NO. 78-501-475
CHKD. BY KULL DATE 5/23/78 SHEET NO. 12 OF 17



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CONCLUSION : ANALYSIS SHOWS THAT TOWNSHIP LINE DAM
CAN CONTAIN AND/OR PASS 44% PMF
OR 44% SDF

SUBJECT DAM SAFETY INSPECTION
TOWNSHIP LINE DAM
BY DLB DATE 6-5-78 PROJ. NO. 78-501-475
CHKD. BY JTS DATE 6-5-78 SHEET NO. 13 OF 17



CONSIDER AVAILABLE STORAGE VOLUME IF TOP OF DAM ELEVATION WERE TO BE LEVELED OFF AT EL 1285 ACROSS ITS ENTIRE LENGTH.

SURFACE AREA (EL 1280 NORMAL POOL)	= 55.3 ACRES
SURFACE AREA (EL 1285 TOP OF DAM POOL)	= 64.0 ACRES
SURFACE AREA (EL 1270)	= 43.2
SURFACE AREA (EL 1272.6 PRESENT POOL)	= 46.3

NOTE: Top of Dam & Normal Pool Areas were planimetered off DRWG 97-146F from Citizens Water Co. The area for Present Pool has been interpolated.

$$\text{AVAILABLE VOLUME} = (1285 - 1272.6) \times [(46.3 + 64.0)/2] = 683.9$$

REQUIRED RESERVOIR STORAGE (SHEET 10) = 1280 AC-FI

VOLUME STORAGE AVAILABLE < REQ'D RESERVOIR STORAGE
684 AC-FI < 1280 AC-FI

AT TOP OF DAM EL 1285 WHAT PMF OR SDF WILL THE DAM PASS AND/OR CONTAIN

JECT DAM SAFETY INSPECTION

TOWNSHIP LINE DAM

Y DLB DATE 6-5-78 PROJ. NO. 78-501-475

CHKD. BY JTS DATE 6-5-78 SHEET NO. 14 OF 17



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$$P = \frac{\text{MAXIMUM DISCHARGE RATE}}{Q_{I\text{MAX}}} = \frac{130.7 \text{ cfs}}{Q_{I\text{MAX}}} \quad (\text{SHEET } 9)$$

$$1 - P = \frac{\text{AVAILABLE STORAGE VOLUME}}{\text{VOLUME OF INFLOW HYDROGRAPH}} =$$

$$1 - \frac{130.7}{Q_{I\text{MAX}}} = \frac{684 \text{ ACRE-FT}}{1.24 Q_{I\text{MAX}}}$$

$$1.24 Q_{I\text{MAX}} = (1.24)(130.7) + 684$$

$$Q_{I\text{MAX}} = 682$$

$$\text{PMF (PEAK INFLOW)} = 1160$$

$$Q_{I\text{MAX}} = 58.8 \% \text{ PMF}$$

SUBJECT DAM SAFETY PROGRAM
TOWNSHIP LINE DAM
BY JTS DATE 5-4-78 PROJ. NO. 28-501-475
CHKD. BY DLB DATE 5-4-78 SHEET NO. 15 OF 17



TAILWATER CONDITIONS

BASED ON FIELD OBSERVATIONS, IT IS ASSUMED THAT THE MAXIMUM DEPTH OF TAILWATER WILL BE NO GREATER THAN THE HEIGHT OF THE BOX CULVERT (4.4 FT) AND THE FREEBOARD (1.6 FT) SO THAT THE MAXIMUM ELEVATION OF TAILWATER WILL BE \leq 6.0 FT.

THE FIRST HOUSE DOWNSTREAM IS LOCATED SUCH THAT THIS DEPTH WOULD HAVE NO EFFECT ON IT, BUT THE FLOODING DUE TO FAILURE OF THE DAM WILL LIKELY HAVE A DETRIMENTAL EFFECT. THUS FAILURE OF THE DAM WOULD SUBSTANTIALLY INCREASE THE HAZARD TO LIFE AND PROPERTY.

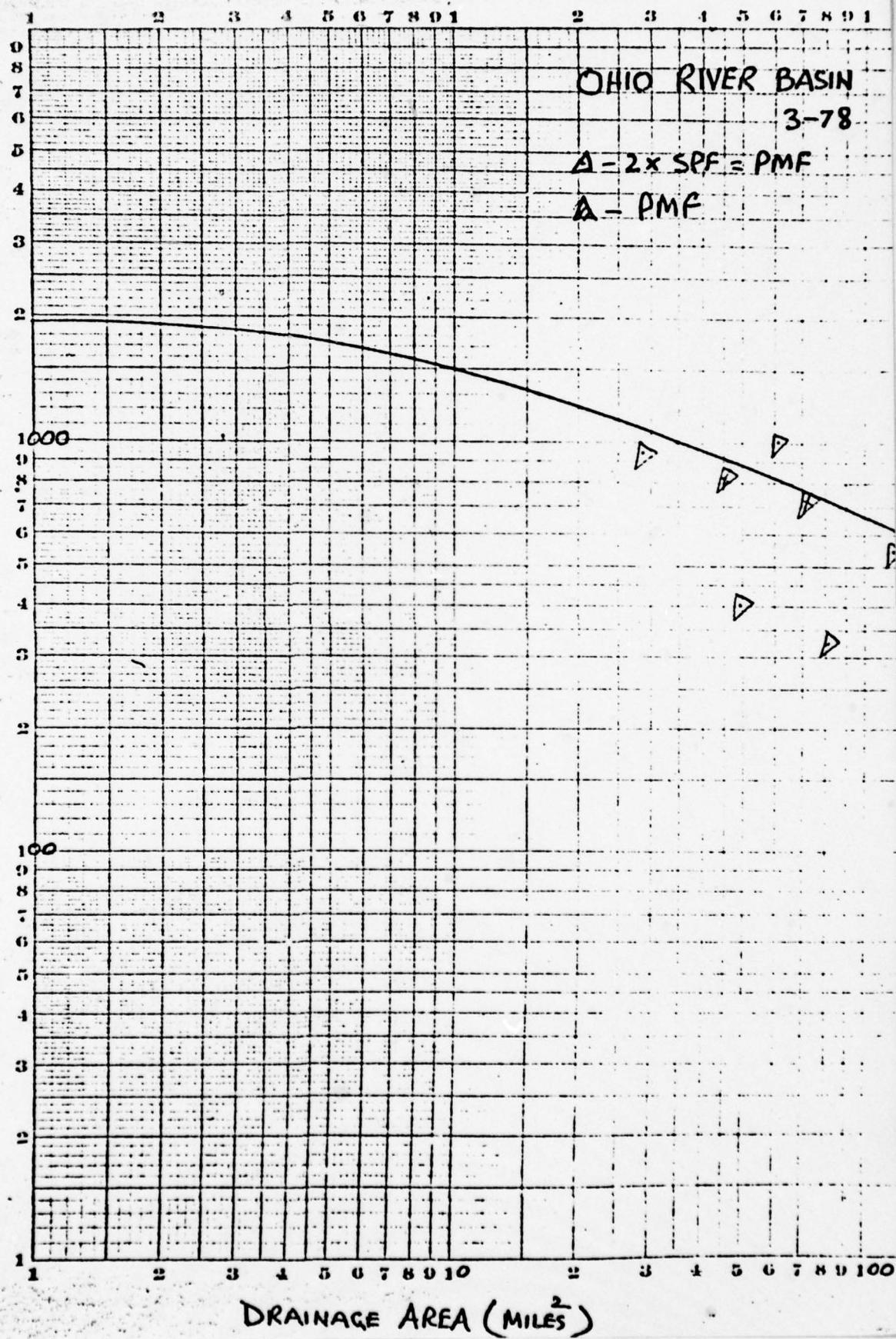
SHEET NO 16 OF 17

CUDEX BOOK COMPANY, INC., NORWOOD, MASSACHUSETTS

NO. 4123. LOGARITHMIC BY 3-INCH CYCLES.



PMF PEAK FLOW / AREA
CFS / mi²



DRAINAGE AREA (MILES²)

A = 2 × SPF = PMF

A = PMF

3-78

OHIO RIVER BASIN

SHEET NO 12 OF 12

TOTAL TIME IN Hours

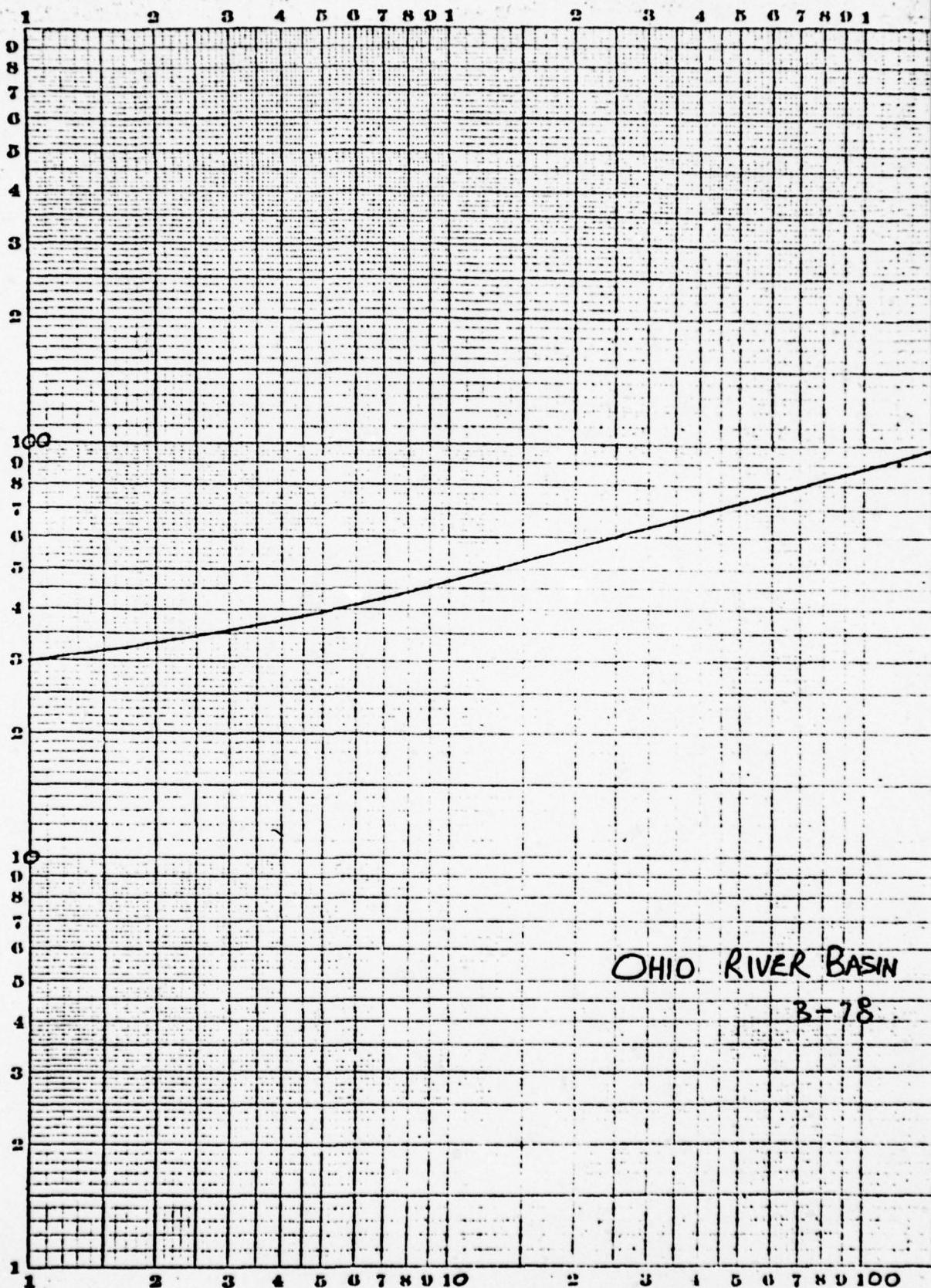
NO. 4123. LOGARITHMIC BY 5-INCH CYCLES.

CODEX BOOK COMPANY, INC., NORWOOD, MASSACHUSETTS

DRAINAGE AREA (MILE²)

OHIO RIVER BASIN

B-78



adu mohi nadii mohi qidawot li weiv J. HANOTON
yastax xit . 2101 liiqs li qidawot liel
baawerdan li uus ad uus (yastax)
qidawot liiqs li uus ad uus

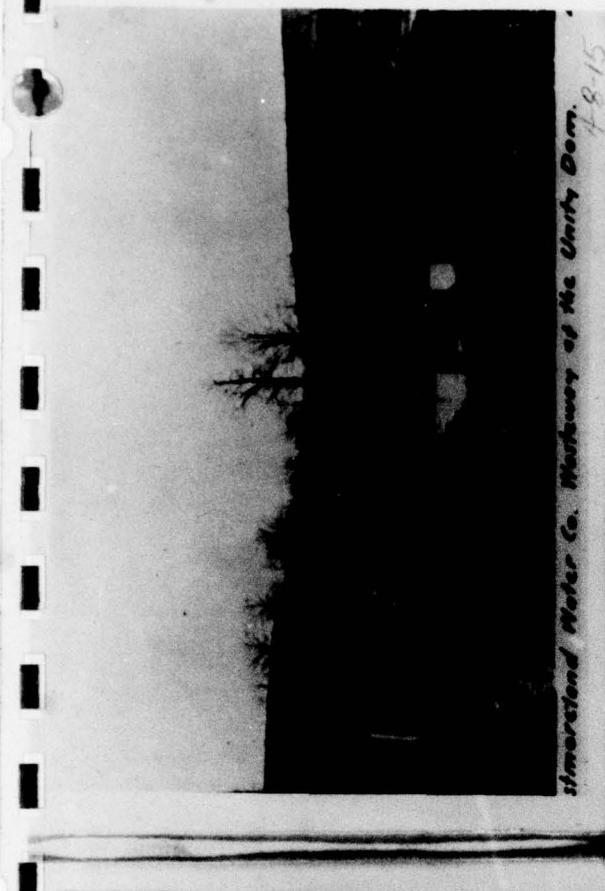
APPENDIX D
PHOTOGRAPHS

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PHOTOGRAPH 1 View of Township Line Dam taken from the left abutment in April 1915. The wasteway (spillway) can be seen in the background of the photograph on the right abutment.

PHOTOGRAPH 2 Close-up view taken in April 1915 showing the wasteway on the right abutment. Note the vertical steel grating. The wasteway discharges into a 24-inch terra-cotta pipe.

PHOTOGRAPH 3 A view from the crest of the Township Line embankment showing the area just downstream as it appeared in 1915.



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- PHOTOGRAPH 4** View of Township Line Dam in the extreme background of the photograph. Note that the trees are submerged near the right side of the photograph indicating that the water level was higher than normal at the time of inspection. According to the owner, the water level is at its highest level at this time of the year.
- PHOTOGRAPH 5** View of the Township Line Run embankment from the wasteway mentioned above. Note that the crest of the embankment has settled. A difference of 3-1/2 feet was measured over the crest of the embankment at the time of inspection.
- PHOTOGRAPH 6** Close-up view of the wasteway as it appears today. The 24-inch terra-cotta pipe can be seen near the left corner of the wasteway.
- PHOTOGRAPH 7** View showing the downstream portion of the Township Line embankment. Note the dark areas near the toe of the embankment. They are shallow depressions where sloughing has occurred.



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PHOTOGRAPH 8 View of the downstream portion of the embankment taken from the area just downstream of the left abutment. The stone structure in the left portion of the photograph is an abandoned pumphouse (pump, valves, etc., have been removed).

PHOTOGRAPH 9 View of the downstream portion of the embankment showing (in shaded areas) several small depressions which exist near the toe of this embankment.

PHOTOGRAPH 10 View of one of the numerous rodent holes on the downstream slope of the embankment. The pipe in the photograph is probably an abandoned aeration line.

PHOTOGRAPH 11 This is a close-up view of one of the rodent holes approximately 20 feet above the toe of the embankment. Note that the six-foot rule has been inserted 1-1/2 feet into the embankment.



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PHOTOGRAPH 12 View of the six-foot rule after extracting it from the rodent hole. The tip of the rule was saturated, indicating that the phreatic surface may be within 1.5 feet of the surface at this point.

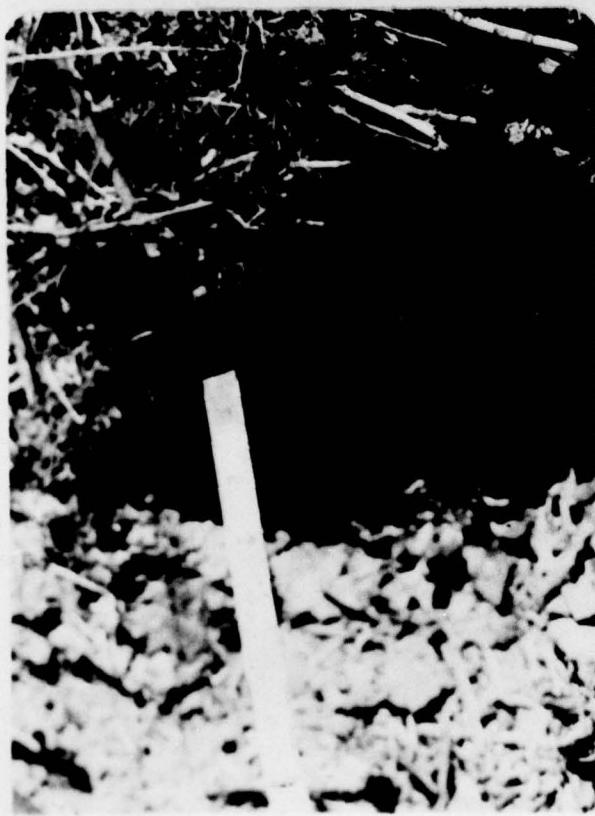
PHOTOGRAPH 13 View of the area near the right abutment at the toe of the embankment showing considerable seepage (arrow shows standing water). The seepage zone extended as high as 11 feet vertically above the toe of the embankment.

PHOTOGRAPH 14 View from swampy area downstream of the Township Line Dam. Water was discharging through a 12-inch corrugated metal pipe at this location, however, the inlet end of this pipe was dry and the source of the flow could not be determined.

PHOTOGRAPH 15 View of the manhole just downstream of the Township Line embankment. Within this manhole are three valves previously used to control the flow in the supply line of Township Line Run Reservoir as well as direction of flow of water from Immel Reservoir.



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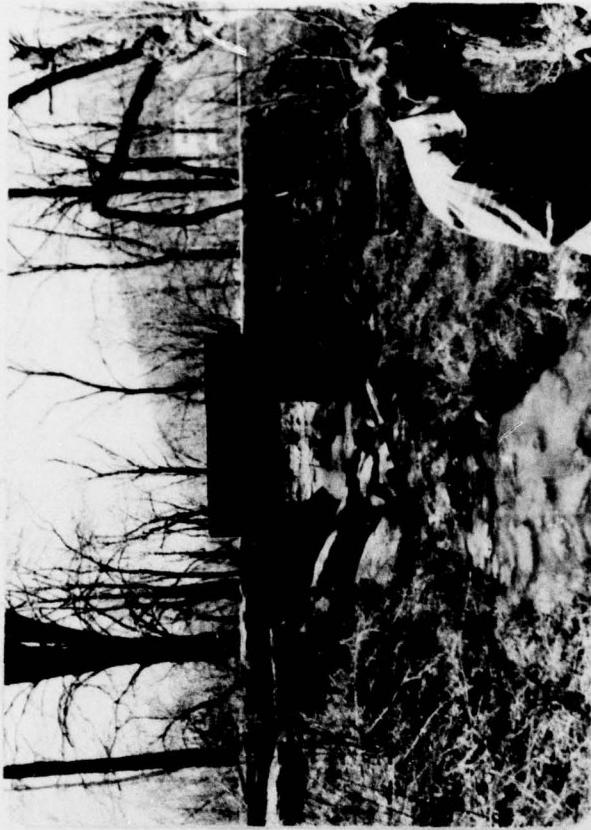


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PHOTOGRAPH 16 View taken approximately 1/2 mile downstream of the Township Line Dam of a concrete weir across the old stream valley. Much of the weir had settled into the stream channel, however, a portion can still be seen in the center of the photograph. Records from the early 1900's make reference to weirs which were installed to measure seepage.

PHOTOGRAPH 17 View of two-lane bridge approximately one mile downstream of the Township Line Dam. The bridge is the first downstream improvement beyond the barn located near the toe of the Township Line Dam. Note the housing development visible in the upper right corner. The two lowest houses in the development are considered hazard prone.

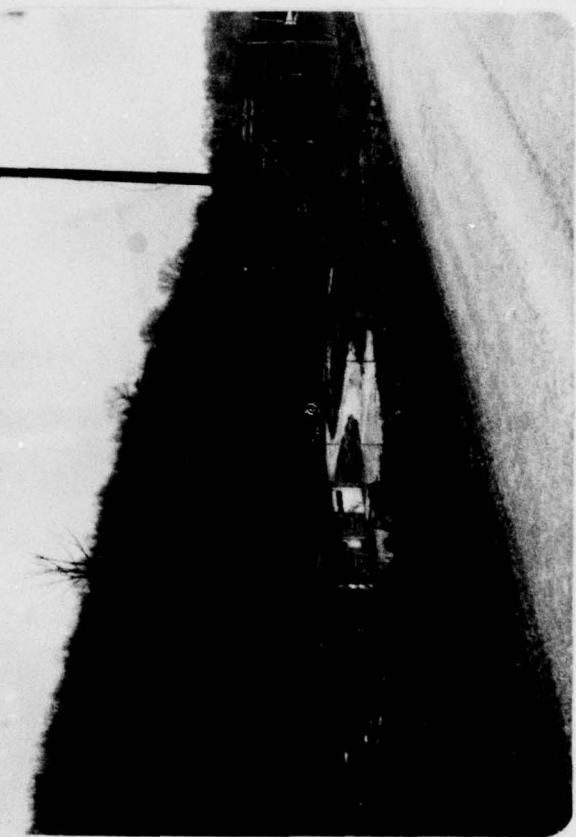
PHOTOGRAPH 18 View of the sewage treatment facility located on the floodplain approximately 9,000 feet downstream of the Township Line Dam.



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APPENDIX E

GEOLOGY

Township Line Dam is located along the axis of the Fayette Anticline in the shales and sandstones of the Pennsylvanian age Conemaugh Formation. The rocks dip away from the axis of the anticline at approximately 3°.

At the time of inspection, a sandstone unit was noted cropping out along Route 130 a few hundred feet from the southwest corner of the dam. The rock in this area contained numerous open joints. In addition, water was observed to be discharging from the hillside at the level of the sandstone approximately 1,500 feet downstream of the dam suggesting continuity of the jointing toward the abutment.

APPENDIX F

FIGURES

APPENDIX F - FIGURES

<u>Figure</u>	<u>Description/Title</u>
1	Plan of Township Line Dam and Appurtenances Showing Pre- and Post Construction Contours
2	Property Map of Unity Reservoir (Township Line Reservoir)
3	Plan and Cross Section of Township Line Dam
4	Location Plan - Pump Station and Pipe Lines
5	Detail Plan - Pump Station
6	Capacity Curve - Township Line Reservoir

PROPOSED RESERVOIR
WESTMORELAND WATER CO.
Scale 1 in = 1 mi

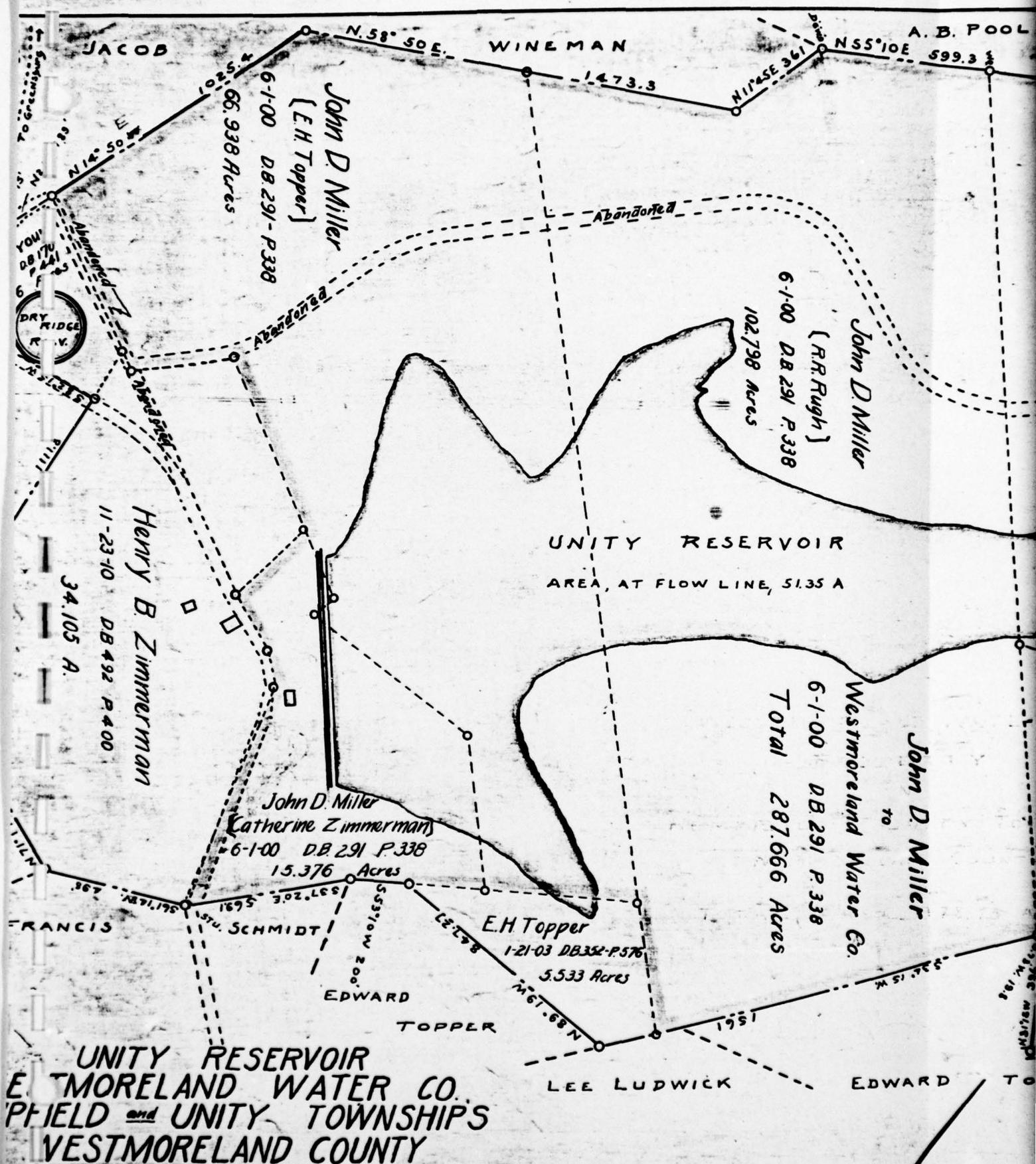
~~Water flowing from bottom of Reservoir~~

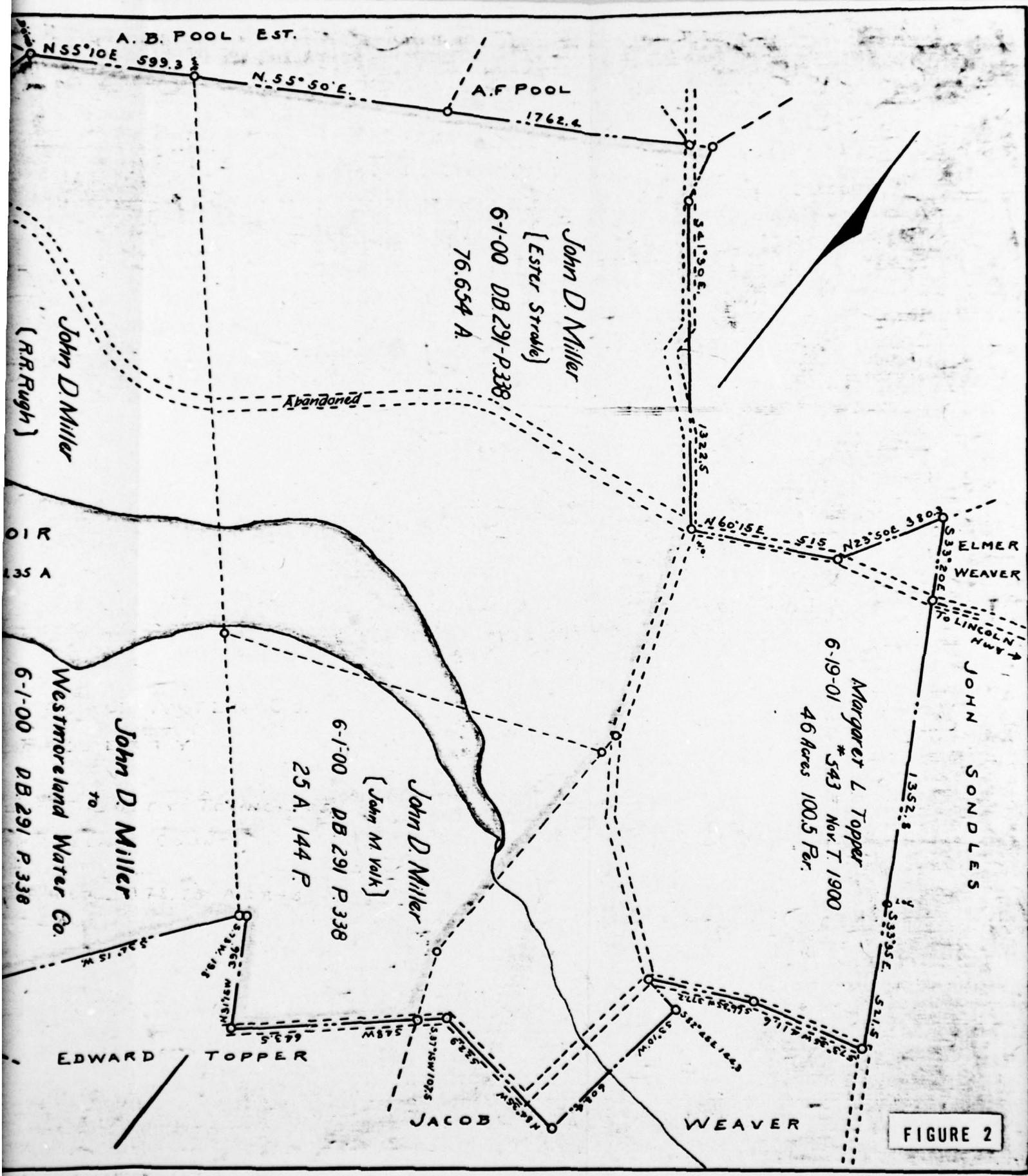


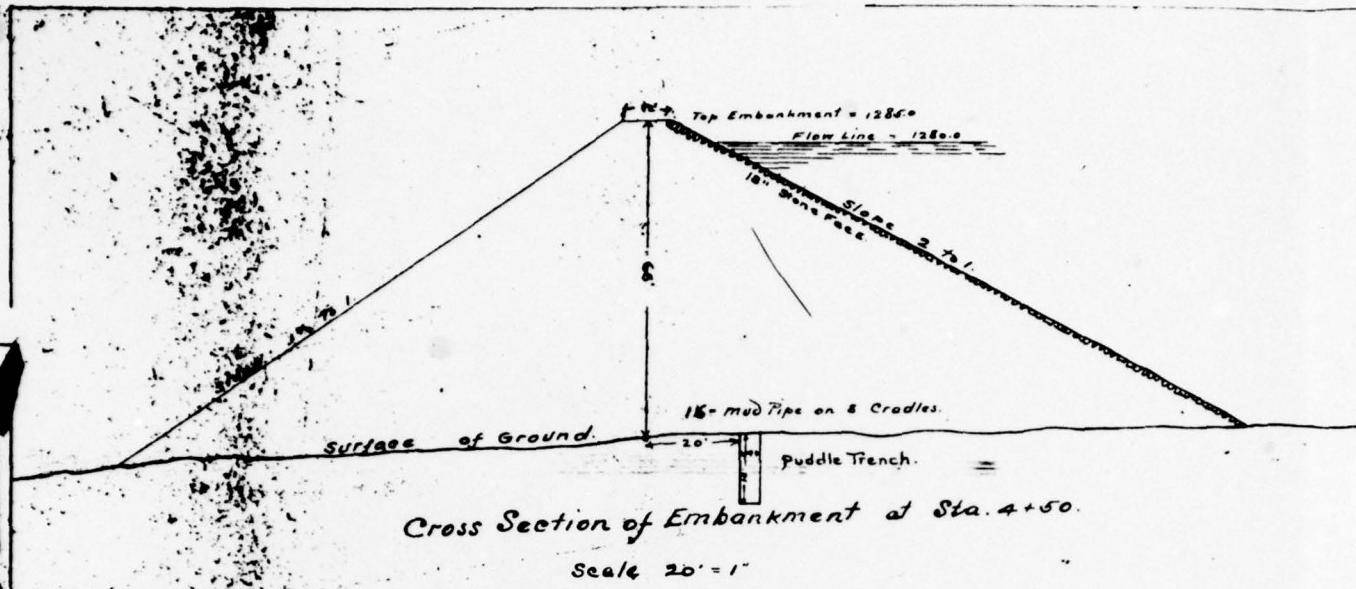


27-146R
FIGURE 1

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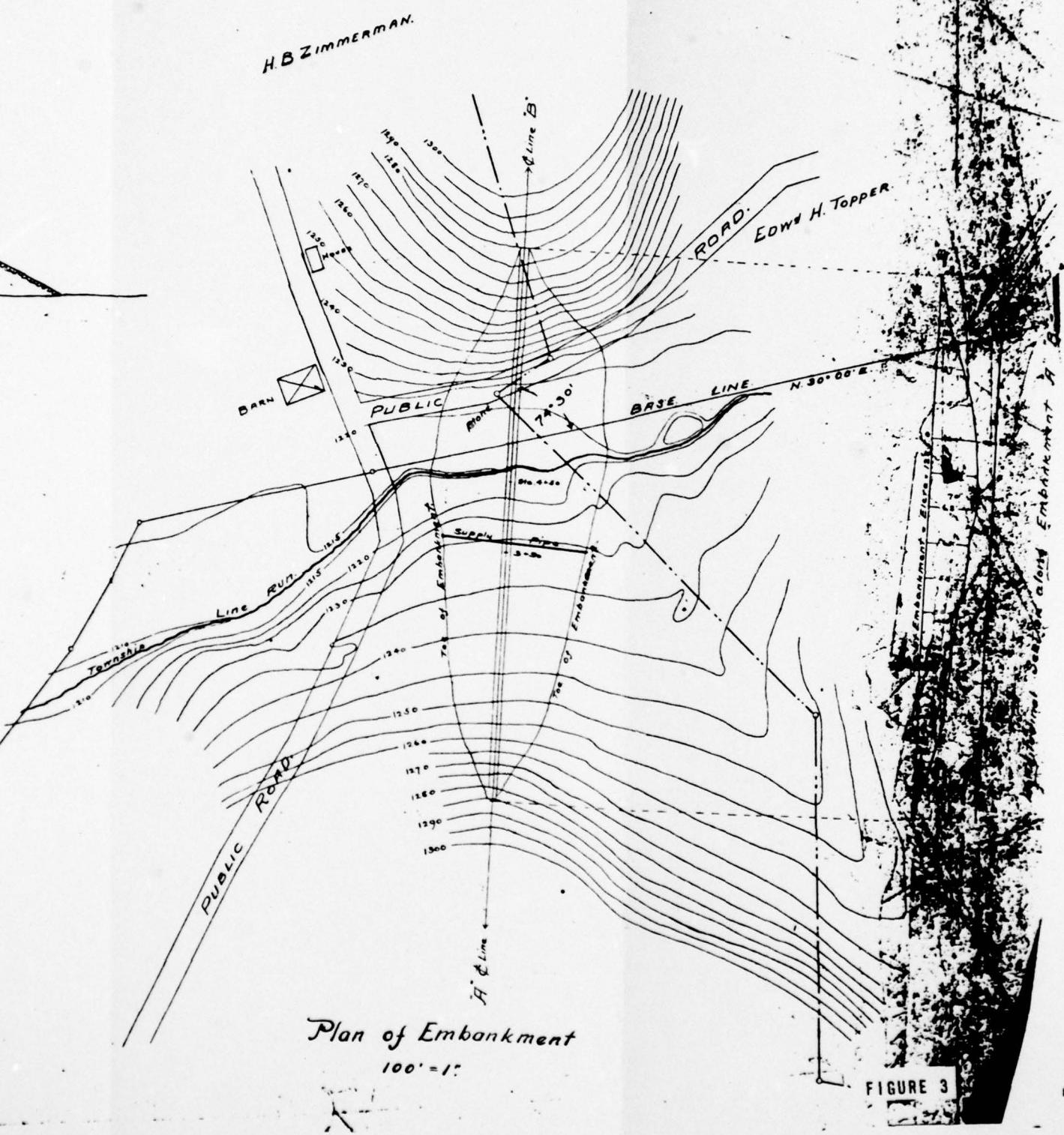


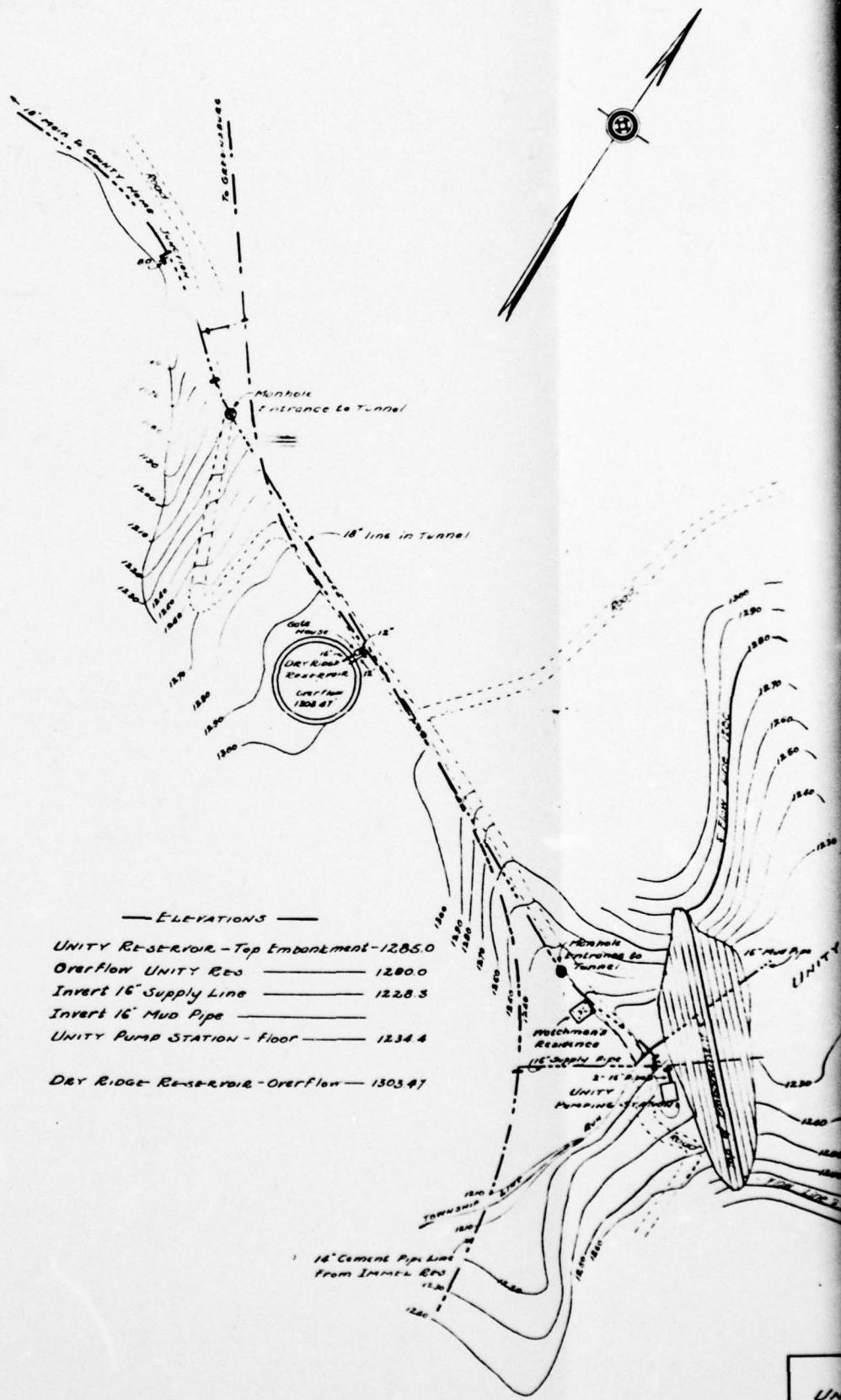




Monocacy River Co.







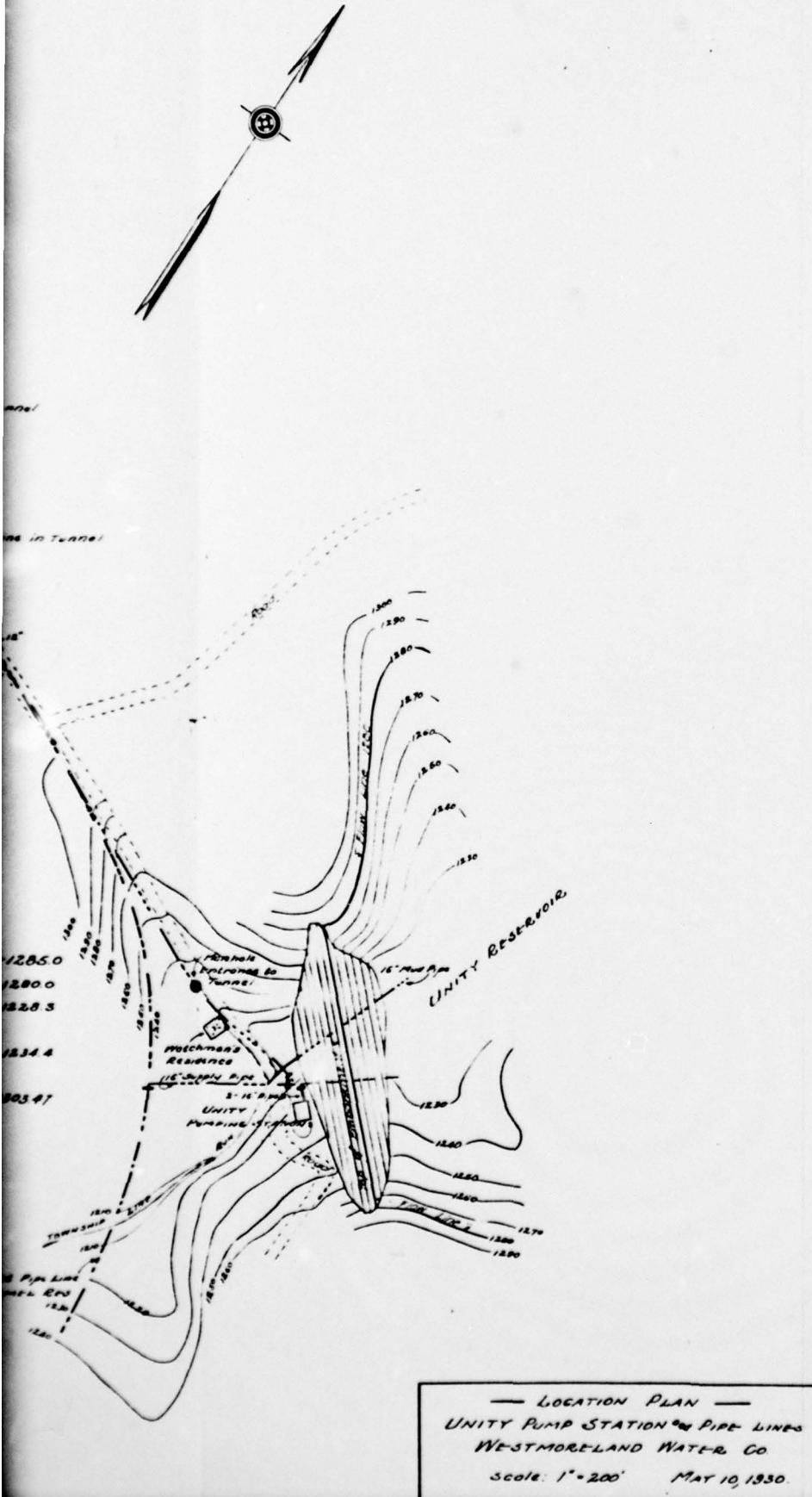
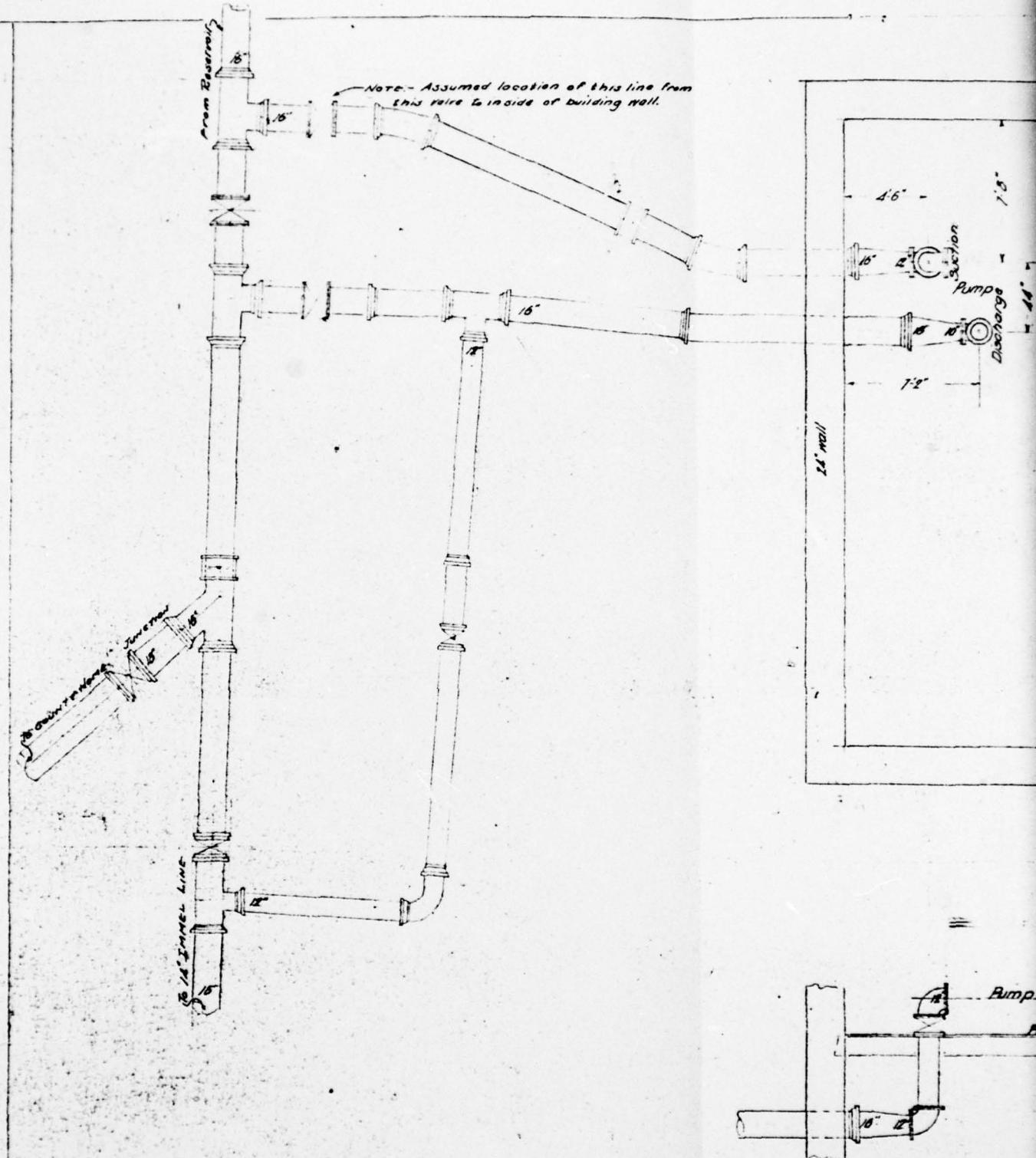
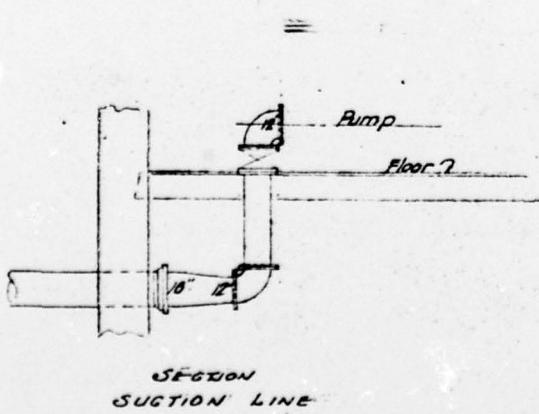
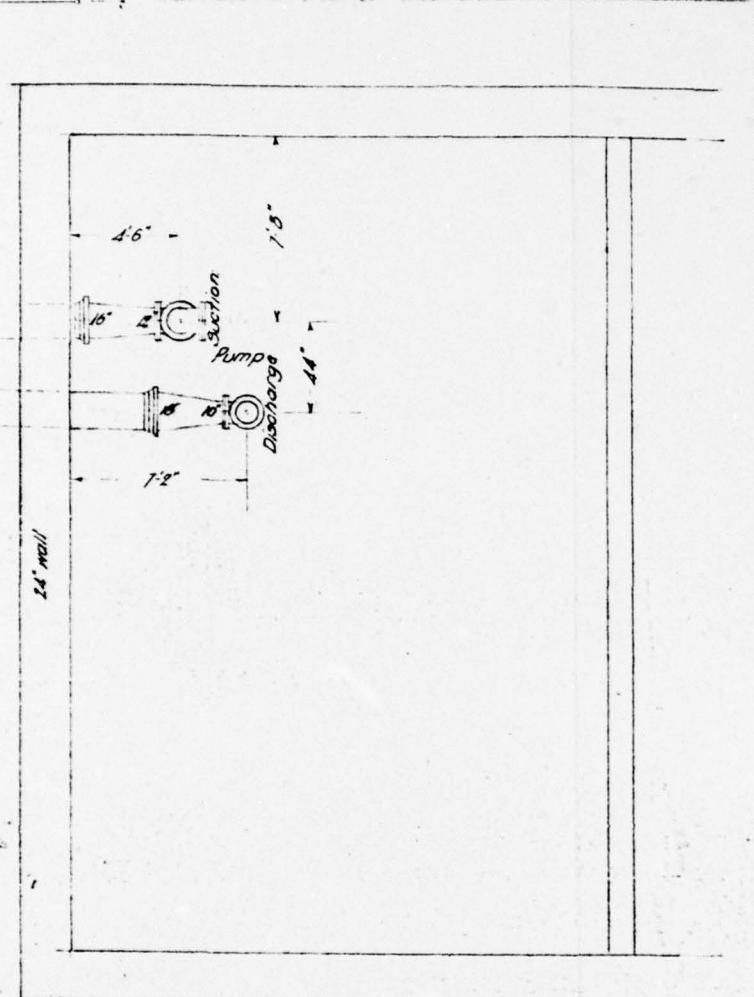


FIGURE 4



SECTION
SUCTION LINE

position of this line from
side of building wall.



DETAIL PLAN
UNITY PUMP STATION
WESTMORELAND WATER CO.
SCALE: $\frac{1}{16}$ = 1'-0" MAY 10, 1930.

FIGURE 5

NO. 334-2TR, 10 X 10 TO THE HALF INCH.
MADE IN U. S. A.
100% RAG PAPER

